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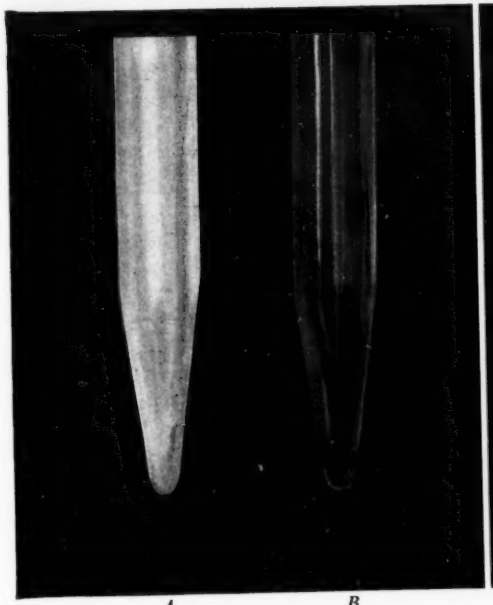

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Fig. 1. Voided specimens of urine from patient with chyluria. *A*, Before etherization. *B*, After etherization.

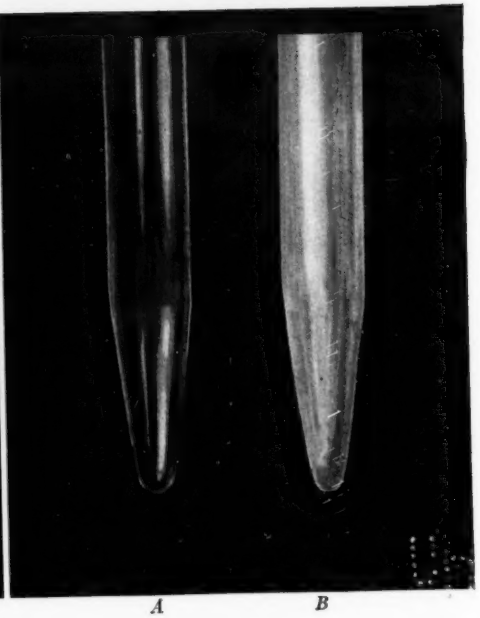

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Fig. 2. Specimens of urine from the kidneys of patient with chyluria. *A*, Clear urine from right kidney. *B*, Creamy white urine from left kidney.

Chyluria; with Report of a Case Treated with Neosalvarsan.—William E. Lower and George W. Belcher.

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CHYLURIA

WITH A REPORT OF A CASE TREATED WITH NEOSALVARSAN

BY WILLIAM E. LOWER, M.D., F.A.C.S., AND GEORGE W. BELCHER, M.D., CLEVELAND, OHIO
Cleveland Clinic

OUR recent observation and treatment of a case of apparently non-parasitic chyluria led to a careful search of the literature which has revealed reports of only twelve similar cases. In each of these, the diagnosis was based upon the fact that a search for parasites and ova had been fruitless. Since some of these cases like our own showed an eosinophilia, and since it is well known both that the filaria sanguinis hominis is often extremely difficult to isolate and that filarial infections often may disappear for months, the true etiology in some of these reported cases and also in our own would appear to be doubtful.

Because of the rare occurrence of chyluria and the doubtful etiology in the so-called non-parasitic cases, it has seemed worth while to offer this report and a brief review of the literature pertaining to chyluria.

Authors' case. The patient, a Chinaman, a cook by trade, was referred to the Clinic by Dr. D. K. White. The patient reported here July 12, 1923, his chief complaint being thick, light colored urine and general weakness. Five months before the patient had first noted the sudden passage of milky urine. There was no burning on urination, no frequency, and no hæmaturia (macroscopic). The patient thought that possibly he had had a cold at the time of onset of the trouble but except for a little general weakness, he felt very well. His appetite was good; the bowel movements were regular and normal in character; sleep was normal. He had had no pain whatsoever. His employment had not been interrupted, although he had lost from 10 to 15 pounds during the last 5 months. There had been no cough, sputum, fever, œdema, ascites, skin trouble, fluttering of the heart, or headache. There was no history of trauma.

The patient had lived in the northern part of the United States for the past 10 years, before which time he had resided in Hongkong and in Canton, China. He had never had any chyluria or any related disease before the beginning of the present attack which had shown no remissions since its onset. His diet was unusually non-oriental and had been so for years. With the exception of a mild attack of influenza in 1918, there was no history of any previous illness.

Examination showed the patient to be a healthy looking Chinaman, height 5 feet, 6 inches, weight 135 pounds. The sensorium was clear; the color good. There was no general glandular enlargement. A painstaking complete physical examination disclosed no abnormal condition. The reflexes were present, equal and active. The prostatic and seminal secretions were normal in character and amount. The Wasserman test was negative.

The blood pressure was 96-60; temperature, 97.8 degrees; pulse, 66; respiration, 24. No filariæ were found in the blood.

Blood count. Red blood cells, 4,450,000; white blood cells, 8,400; hæmoglobin, 80 (Dare 84).

Differential count. Polymorphonuclear neutrophiles, 76.5 per cent; polymorphonuclear eosinophiles, 5 to 7 per cent; polymorphonuclear basilophiles, 2.5 per cent; small lymphocytes, 14.0 per cent; large lymphocytes, 0.5 per cent; and transitionals, 1.5 per cent.

Blood chemistry. Sugar, 0.112 gram per 100 cubic centimeters; acetone, negative; urea, 33 milligrams

Fig. 3. Pyelogram of left renal pelvis of patient with chyluria (left). As noted in the text, the minor calyces are practically lacking but there is no evidence that this indicates a pathological condition.

per 100 cubic centimeters; uric acid, 2.9 milligrams per 100 cubic centimeters; creatinin, 1.54 milligrams per 100 cubic centimeters; chlorides, 565 milligrams per 100 cubic centimeters; lipæmia, negative.

Repeated examinations of the stools disclosed neither parasites nor ova.

The urine was always very milky in appearance, slightly more so in the morning than throughout the day. It never showed a reddish tinge, although the microscope disclosed the presence of red blood cells. Urinalysis gave the following findings:

Reaction, acid; color, cream; odor, none; specific gravity, 1.014–1.017; appearance, milk-like emulsion; protein, 0.84 grams per liter; mucin, present; glucose, negative; indican, negative; cholesterol, trace; acetone, negative; diacetic acid, negative; beta-oxybutyric acid, negative.

Urinary fat. Grease-spot test, positive; etherization, clear (oil extracted) (Fig. 1, frontispiece); Babcock test, fat 0.45 to 1.0 per cent.

The microscopic examination of the urine was negative as shown by the following report: Red blood cells, small number; white blood cells, numerous; bacteria, occasional large gram-negative bacillus, no tubercle bacilli; sediment, no filaria, hooklets, or ova; no casts.

The X-ray examination of the urinary tract was negative. The X-ray examination of the chest showed some peribronchial thickening, but as a whole, the chest examination was negative.

First cystoscopy. July 16. The cystoscope passed easily. There was no residual urine and the bladder urine was similar to the voided specimen. The bladder capacity was 175 cubic centimeters. There was no stone, tumor, ulcer, sinus, or diverticulum in the bladder. The mucous membrane showed a mild generalized hyperæmia. The ureteral orifices were normal, similar in form, and showed no localization of the general hyperæmia. The ejaculation from the right ureter was clear in appearance while that of the left side was creamy white. The sphincter margin was normal in outline and showed no relaxation. The catheters passed easily to each renal pelvis and there was no retention on either side. As the specimen of urine from the right ureter was clear and that from the left was creamy white, the impression was that we were dealing with a chyluria, left renal in origin (Fig. 2, frontispiece). The specimen from the right kidney showed no infection. The left kidney showed a colon bacillus infection.

URINALYSES OF URETERAL SPECIMENS

	Right Kidney	Left Kidney
Color	Clear amber (Fig. 2)	Creamy white (Fig 2)
Reaction	Acid	Acid
Sugar	None	None
Blood	None (Macroscopic)	None (Macroscopic)
Bile	None	None
Microscopic examination:		
Red blood cells	Few	Numerous
White blood cells	Occasional	Few
Casts	None	None
Crystals	None	None
Bacteria	None	*Few large bacilli*
Tubercle bacilli	None	None

Differential functional test: 1 cubic centimeter phenolsulphonephthalein, intravenously.

	Right Kidney (normal)	Left Kidney (chyluria)
Time of appearance	4½ minutes	3 minutes
Output first 10 minutes	7 per cent	13 per cent
Obtained from bladder at end of 10 minutes,		5 per cent
First 10 minutes, total output		25 per cent

The patient's apprehension made it impossible to prolong this test. The secretion from the right kidney was just as heavy as that from the left, but not nearly as frequent. We concluded, therefore, that the bladder contents represented an extracatheter flow from the right kidney.

Pyelogram. The distention of the left renal pelvis required the injection of 7 cubic centimeters of the solution. The pyelogram (Fig. 3) is atypical, as the minor calyces are practically lacking but we did not believe this betokened a pathological condition.

A second cystoscopic examination on July 28, at which time the above functional test was carried out, showed the same conditions as those found on July 16. By this time, that of the second cystoscopy, the infection on the chyluria side (left) had been cleared up by antiseptics.

In the few cases previously reported, some of the authors tried various procedures in an effort to vary

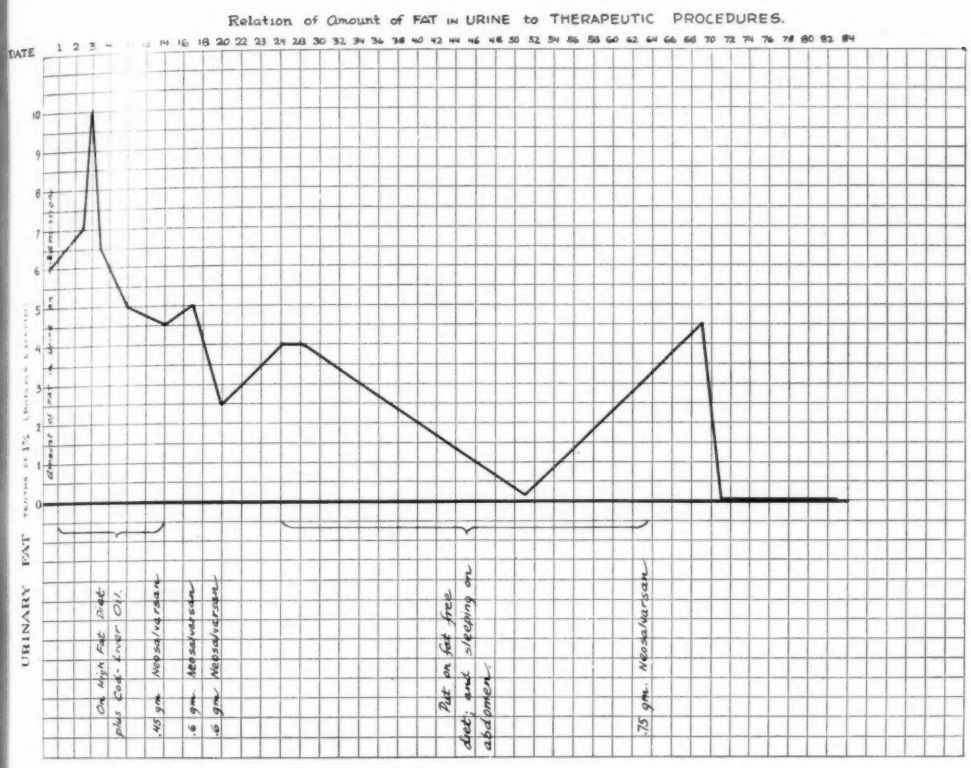
Relation of Amount of FAT in URINE to THERAPEUTIC PROCEDURES.
DATE
URINARY FAT
On high fat diet plus Cod-liver Oil
.45 gm. Neosalvarsan
.6 gm. Neosalvarsan
.6 gm. Neosalvarsan
Put on fat free diet, and sleeping on abdomen
.75 gm. Neosalvarsan

Fig. 4. Chart showing variations in urinary fat in patient with chyluria under treatment with neosalvarsan.

the fat output of the urine. We also applied these to our case, with the following results:

The effect of posture. Hampton (11) in his very complete case report found that posture influenced but did not control his patient's hæmatochyluria. Its effect in our case was about nil. In striking contrast to this are the cases of Hnatek (10) and Charteris (6). The former's patient, with a bilateral chyluria, put out twice as much fat in bed as at other times, and four times as much fat from the left kidney as from the right. In Charteris' case, chyluria could be produced at any time by drinking a glass of milk and reclining at an angle of 45 degrees. Irrespective of the diet, our patient's morning and evening urine varied little—viz.:

	First morning specimen	Late afternoon specimen
On regular diet.....	0.7 per cent fat	0.6 per cent fat
On fat-free diet.....	0.4 per cent fat	0.4 per cent fat

The effect of diet. We next put the patient on a diet with a high fat content, much more than he was accustomed to taking, and in addition, he took cod-liver oil. There was only an exceedingly slight increase in the output of fat (see Fig. 4). This result agrees with that obtained by Carter (3). A fat-free diet caused the fat output to decrease but not to disappear. Under the same conditions the urine of Hampton's patient became fat-free.

The effect of salvarsan. The effect of salvarsan and its derivatives on cases of parasitic chyluria is at present a very much disputed point. Cures have been reported by Deschamps (8) and by Chabanier and Lobo-Onell (5). In both of Deschamps' cases the filarial parasite disappeared from the urine. The urine, which coagulated in the bladder to such a degree as to clog the urethra, was made more fluid by the administration of sodium citrate. In the case of Chabanier and Lobo-Onell, rapid diminution of symptoms was obtained by the use of arsenobenzol. It was argued, however, that this result may have been due to the presence of gummatous obstruction of the lymph channels somewhere in the urinary tract.

Our patient was given three intravenous injections of neosalvarsan (D. R. L.)—0.45 gram, 0.6 gram, and 0.6 gram respectively. On the day of the last injection, the fat output (urine) was 0.25 per cent or

lower than it had ever been during our observation of the case. Six days later, the patient remaining on a fat-free diet, the fat output had again increased to 0.4 per cent. Thirty-one days later, the urine was practically clear. A small number of red blood cells and an inestimable trace of fat were still present.

Forty-three days later, the patient returned with a complete recurrence. The urine contained 0.3 per cent fat and numerous red blood cells. He was given 0.75 gram of neosalvarsan and 6 days later or 49 days after the first course of neosalvarsan, his urine showed 0.45 per cent fat. Two days later it was entirely negative, not even red blood cells being present. This was the first time that the urine had become entirely normal since the patient had first come under our observation. The urine was still fat-free on October 5 and on November 16, the date of his last visit. The eosinophilia, however, has persisted.

Salvarsan or its derivatives may be very effective in cases of parasitic chyluria especially when that condition is due to obstruction of the lymph channels by ova or by the parasites themselves. This is still an open question, however. In those cases in which the obstruction is either non-parasitic or is due to secondary changes following parasitic infections, such as fibrosis, stricture and calculi formation, it is hard to understand how salvarsan could have any effect.

Our own interest in this case and its unexpected progress has led us to collate from the literature the known facts regarding the disease.

DEFINITION

Chyluria denotes the presence of chyle or lymphatic contents in the urine, the fats appearing as milk-like emulsions or mixtures of fatty acids, neutral fats, and soaps. Chyluria associated with an extremely small urinary fat output has been referred to as lymphuria (15). In lipuria the fat is present as such in the urine and appears in little globules.

ETIOLOGY

The three principal types of chyluria with their respective causes or associated conditions are grouped as follows:

1. Parasitic chyluria	1. Filaria sanguinis hominis 2. Echinococcus 3. Cysticercus cellulosæ 4. Ascaris lumbricoides 5. Associated with malaria
2. Non-parasitic chyluria	1. Thoracic duct obstruction 2. Trauma 3. Tuberculosis 4. Infection (localized abscess) 5. Pressure of neighboring tumors upon thoracic duct 6. Aneurisms (extasia) of the lymphatics
3. Functional chyluria	1. Simple chyluria (Sanes and Kahn, 26) 2. Chyluria associated with diabetes (Monvenoux, 21) 3. Chyluria associated with pregnancy (Veis, 28; Davis, 7)

Parasitic chyluria. Adami and Nicholls (1) in their *Principles of Pathology* list the following parasites as having been found in the kidney or kidney pelvis:

Parasites found in the kidney:
1. Echinococcus
2. Cysticercus cellulosæ
3. Distoma hæmatobium (schistocomiasis)
4. Eustrongylus gigas
5. Filaria sanguinis hominis
6. Pentastomum denticulatum

Parasites found in the pelvis of kidney:
1. Filaria sanguinis hominis
2. Distoma hæmatobium
3. Eustrongylus gigas
4. Ascaris lumbricoides

The literature, however, contains practically no reports of parasitic chyluria other than those due to the filaria sanguinis hominis. Quarelli (23) announces the observation of intermittent chyluria during the febrile paroxysms in a case of æstivo-autumnal malaria, when the phenomenon would last for 10 to 12 hours. Quarelli's belief that it suggested latent malaria is supported by the fact that quinine therapy caused the disappearance of the chyluria.

Remlinger (24) reports the cases of a man and of a woman who eliminated in the urine the membranes and vesicles from an echinococcus cyst above the bladder. No operation was attempted in either case and the general condition had been fair to the date of his report. In both cases the chyluria was thought to be due to compression. It had existed long before there was anything to suggest the presence of echinococcus disease.

Carter's (3) case which cleared up under salvarsan, had a positive Wassermann; and strongyloides stercoralis embryos were found in the stools.

A parasite such as the filaria sanguinis hominis, for example, may cause lymphatic rupture in a number of ways. The larvæ may block the lymphatics or the thoracic duct itself; secondary inflammatory changes due to the presence of parasites may cause obstruction by stricture or calculi (MacKenzie's case, 17); or the larvæ may create false passages as a result of their burrowing.

Non-parasitic chyluria. That any process which produces lymphatic obstruction may cause chyluria is obvious. In these cases an important point to be kept in mind has been stated by Warthin (29), who says that chyluria takes place in the presence of thoracic duct obstruction *only when the collateral lymphatic circulation is inadequate.* The adequacy of the latter is suggested by the frequent occurrence of potentially obstructive tuberculous lesions of the thoracic duct as compared with the rare occurrence of chyluria.

Functional chyluria. Since the exact point of communication between the lymphatic and urinary systems has never been definitely determined in any case of chyluria, it would seem doubtful if such a condition as functional chyluria really exists. Sanes and Kahn (26), however, report a bilateral case in which every attempt to determine the etiology, including exploratory operations, was negative. These observers thought that their case was due to the direct passage into the urine of fat from the blood through the kidney epithelium, probably as the result of a functional disturbance of the kidney cells.

PATHOLOGY

Contributions to the pathology of chyluria are very limited. The articles of MacKenzie (17), Havelburg (12), Low (15), and Manson (19, 20) present most of the pathological data to be found in the literature. However, although the exact pathological condition in any case has never been demonstrated because of the difficulty in tracing the lymphatic system, a number of interesting associated conditions have been observed. In the case reported by Hertz (13), although the obstruction of the lymphatic duct was above the diaphragm, only one kidney showed chyluria.

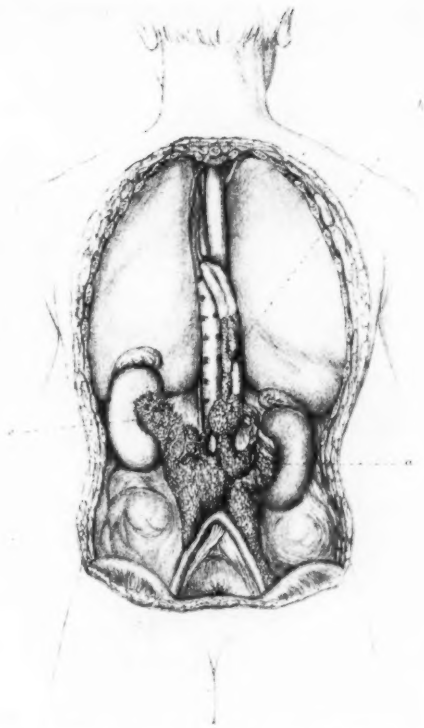

Fig. 5. Illustrating Dr. Stephen MacKenzie's case of filarial hæmatochyluria. Semi-diagrammatic drawing of a dissection of the abdominal and thoracic lymphatics, seen from behind. Made by Mr. E. H. Fenwick. The lymphatics are accurately represented as displayed in the dissection, having been inflated to allow of the sketch. The outline of the trunk and lungs are alone diagrammatic. The left kidney is displaced upward to expose the dissection of the renal lymphatics. *a.* Greatly enlarged iliac, lumbar, and renal lymphatics. *b.* Thoracic duct passing through inflammatory material. *c.* Calculi in left renal lymphatic. (From Transactions of the Pathological Society of London.)

MacKenzie's case, which I quote below, gives the most complete pathological description which has appeared to date. This case which occurred in a soldier who had seen service in India was proved to be filarial in origin. The chyluria, which was marked, was associated with left renal colics. Bronchopneumonia caused death after a gradual downhill course. The chyluria was presumed to originate in the left kidney (Fig. 5). MacKenzie's descriptions of the necropsy findings are as follows:

"The 'thoracic duct' commences in a dense mass of lymphatic tissue and glands, which extend from the bifurcation of the aorta below to the level of the aortic opening of the diaphragm above. Looked at from behind, this mass occupies the whole of the space between the kidneys, and is continuous below with the chains of lymphatic tissue on the iliac arteries. This mass consists very largely of enormously dilated lymph sinuses which can here and there be inflated. The 'receptaculum chyli' commences by two large lymph sinuses about the size of a pencil, one from each side of the aorta, and is joined opposite the aortic opening of the diaphragm by a third large sinus about the same size. The duct now ascends, sinuous and much pouched, for 3 or 4 inches, varying in diameter from 3/16 to 1/2 inch, pervious for the first inch and a half above the aortic opening of the diaphragm, then filled with a loose clot for an inch and a half, after which it is lost in a tough thick mass (query, inflammatory). (The occluded point in the thoracic duct when opened was found to contain a very long, twisted clot, tapering to the end. It is left *in situ*, to be shown before being submitted to microscopic examination.) About 4 inches above this point, when it can again be traced, although still involved in dense tissue, it is now the size of a small crow-quill, impervious, and tending to the left side behind the aorta. At its termination in the angle between the left subclavian and internal jugular veins it passes through a mass of lymphatic tissue, is pervious, and about the size of a goose-quill. As stated, the iliac, the lumbar and renal lymphatics are very much enlarged, the enlargement is especially marked in the left iliac and left renal lymphatics. Scattered throughout the left renal lymphatics are numerous hard, round masses, some the size of a pea, but mostly smaller. These masses manifestly occupy the lymph sinuses."

SYMPTOMS

The appearance or character of the urine may be the only symptom. The condition is peculiarly intermittent, especially when the associated disease is of the parasitic type. The milky urine may suddenly follow the partaking of a meal rich in fats; it may develop after a strain; or it may appear without any demonstrable cause. Osler has observed its appearance during childbirth with subsequent cessation after delivery.

Weakness, loss in weight, and anæmia may precede, accompany, or follow the development of chyluria. Lymph scrotum, elephantiasis, chylothorax, chylopericardium, or chylous ascites may be associated conditions. Renal colic may occur, due to the passage from the kidney of coagulated masses of chylous urine.

DIAGNOSIS

The presence of chyluria is usually easy to determine. The urine is acid, low in specific gravity and looks not unlike milk. It may have a pinkish tinge due to the presence of red blood cells. Unlike frank lipuria, in chyluria as a rule fat droplets cannot be seen under the microscope, but etherization will separate the fat from the emulsion and the exact amount can be determined by the Babcock test. The protein content of the urine is increased. A careful study both of the urine and of the clinical history is necessary to determine the type of chyluria in a given case. This study must include a careful past history of the patient as to residence and infections; and a careful examination of the blood for parasites, of the urine for parasites and hooklets, and of the stools for parasites and ova. These examinations must be made daily for at least a week.

The exact point of communication between the urinary and the lymphatic system usually cannot be determined without operation.

PROGNOSIS

In cases of non-parasitic chyluria, the prognosis of course depends upon the nature of the obstructing agent. If the obstruction is non-malignant and can be both demonstrated and reached by operation, the outlook is good. Recanalization of a thrombus of the thoracic duct may be successful. The postural type may be readily relieved.

It is conceded by various authorities that obstruction due to filariæ is rarely cured. The patient, however, may live for years and die from some intercurrent disease unless the loss of chyle is too great a drain upon his system.

As to functional chyluria, as reported by Sanes and Kahn, no conclusion has been reached concerning the prognosis.

TREATMENT

The treatment of chyluria, like the prognosis, depends on the cause of the condition. Until the cause has been determined the treatment must be symptomatic, including a low or fat-free diet, close investigation as to the effect of posture, especially during sleep, and sodium citrate by mouth if the patient is

troubled with renal colic or with difficulty in urination due to clotting of the chylous urine. Any co-existent urinary infection should be treated persistently.

It should be remembered that chyluria is only a symptom and that therefore if it is non-parasitic and its cause is known, the treatment should be directed to that cause.

The treatment of parasitic chyluria should be that appropriate for the particular parasite present in the individual case.

If all efforts to locate the cause have failed, as in the authors' case, treatment with salvarsan or neosalvarsan should be tried. If that fails, the final resource, if the patient is failing to any great extent because of the drain on his system, is an exploratory operation. In unilateral renal cases, if the findings are negative on exploration, decapsulation should be done with the division of all tissue around the renal pelvis except the blood vessels and nerves. If the kidney producing the chyluria has a poor function, or if decapsulation has failed, a nephrectomy should be done, provided of course the other kidney is normal.

CASES REPORTED IN THE LITERATURE

Chyluria of the parasitic as of the non-parasitic type is rare although it was known by the ancients, as Hippocartes (14) and Galen both speak of it. For a very complete historical review the reader is referred to the article of Sanes and Kahn (26). The only reports of real clinical value, however, are those which have appeared since the discovery of the filaria sanguinis hominis and the advent of the cystoscope.

In 1862 Carter (4) presented two interesting cases apparently filarial in origin. One was in an adult Hindu with lymph scrotum and chyluria; the other occurred in association with a mass in the groin and a discharging lymph sinus. These conditions have since been frequently observed and are explained as mechanical obstructions with subsequent lymphatic rupture secondary to some other cause, such as filariasis or tuberculosis.

In 1862 Waters (30) also presented a case apparently filarial in origin. He thought that the chyluria was due to a "reflex condition of the capillaries of the kidneys, as a consequence of which the albumin, the fibrin, the fat and the blood corpuscles are filtered from the blood vessels and make their appearance in the urine."

In 1882 MacKenzie made the first complete report of a case of chyluria which was proven to be due to filariæ, the parasites being found both in the blood and the urine. This was before the time of the cystoscope but the autopsy, which was very unusual and is described above, caused MacKenzie to believe that the condition was left renal in origin.

The only operative findings ever recorded in cases of this type so far as we have been able to discover, are given in the case of Stuertz (27) and that of Sanes and Kahn. Stuertz did a left nephrectomy, finding in the kidney which had been removed, the Eustrongylus which he thought had caused the chyluria. The patient, however, continued to have chyle in the urine after the operation.

Sanes and Kahn, in their case which was bilateral, found nothing abnormal in the kidneys themselves or in the surrounding viscera and concluded that it was non-parasitic and renal in origin.

In 1908 Luedke (16) reported a case of non-parasitic chyluria in which the urine left the ureters clear but became milky in the bladder. He claimed that the condition was due to a colon bacillus inflammation of the bladder. Magnus-Levy's (18) case was right renal in origin and was associated with diabetes.

In 1911, reporting one of the few autopsies on this condition, Low described his case as a lymphuria, feeling that this was the proper term to apply to a chyluria in which the amount of fat present in the urine was almost nil. As dilated lymphatics were found in both the kidneys and the bladder, Low thought that both had contributed to the leakage.

Hampton concluded that the chyluria in his case of non-parasitic hæmatochyluria was caused by a leakage in the right kidney. Hampton likens the deep lymphatics of the kidneys to the cerebral arteries as the points of lowest resistance in their respective systems and assumes that lymphatic obstruction results in a leakage causing chyluria just as hypertension often results in a leakage which causes apoplexy.

Other cases of no less interest have been reported from time to time by Havelburg (12), Hertz (13), Salkowski (25), Brandenburg (2), Pope (22), and Furness and Stebbing (9).

SUMMARY OF AUTHORS' CASE

1. This was a case of chyluria, left renal in origin.

2. Searches for parasites were negative, in spite of the fact that the patient was Chinese and had an eosinophilia of 5 to 7 per cent.

3. Posture had no effect on the condition.

4. Diet caused little change. Increasing the fat intake did not increase the fat output. A fat-free diet lowered the fat output a little.

5. The differential phenolsulphonephthalein test showed a normal left kidney (chyluria side).

6. The pyelogram was not pathological.

7. Neosalvarsan was directly followed in a few days by complete disappearance of fat, as well as red blood cells, from the urine.

8. On the date of his last visit, the patient had remained fat-free and showed no hæmaturia for one and two-thirds months, although the eosinophilia had persisted.

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HÆMATURIA—ITS SIGNIFICANCE[1]

A BRIEF CLINICAL STUDY OF 821 CONSECUTIVE CASES

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THE presence of macroscopical blood in the urine can be due to a great variety of causes, and generally signifies some serious pathological condition of the urinary tract. It is not a clinical entity which requires treatment but a symptom which demands investigation.

The importance of hæmaturia and the necessity of determining its cause must be recognized by every physician and should be carefully impressed on each patient suffering from urinary hæmorrhage. Notwithstanding all that has been said and written on this subject, there is still a tendency for the medical profession to regard this condition lightly, to treat it without diagnosis, and to consider a cessation of bleeding as an indication of cure. This is largely due to the fact that hæmaturia is usually intermittent in character. During the free interval, while the patient is apparently in perfect health, it is not surprising that both patient and physician should minimize the importance of this danger signal. It is at this time, while there is yet a probability of cure, that the best opportunity for investigation and diagnosis is afforded.

Hæmaturia always means some serious general disease or a lesion somewhere in the urinary tract. This has already been emphasized by Kretschmer with 238 cases and by many others. Before a final decision as to the source and cause of the bleeding is made, a careful history should be taken, and a complete physical examination made. The ingestion of certain drugs such as urotropin, turpentine, phenol, etc., may be the primary cause of the bleeding. Acute and chronic febrile diseases such as scarlet fever, measles, malaria, etc., may produce hæmaturia. Scurvy, pernicious anæmia, purpura, syphilis and parasitic diseases may be accompanied by blood in the urine. But even with this list, we must admit that a great many hæmaturias are due to some surgical lesion of the genito-urinary tract. To impress this fact on all of us more directly I have taken up the study of 3,800 consecutive admissions to our Department at the Royal Victoria Hospital. Of these cases 821 came in complaining of hæmaturia; this number does not include cases where microscopical blood was found at examination but only those in which the patient complained at some time or other of having passed blood in the urine. The list given below gives in tabulated form the number of cases suffering from the definite condition specified, which showed blood in the urine; but it must be observed that all patients suffering from such conditions do not give evidence of blood. The number evidencing blood in each condition herein set down is relatively small. This is especially true of injuries of the kidney, renal tuberculosis, infections of the renal pelves, ureteral stones, bladder stones, growths, etc. The following is a classification of the 821 hæmaturias in 3,800 admissions to the Department of Urology.

CLASSIFICATION OF 821 CASES OF HÆMATURIA

	Number of cases
Kidney	
1. Trauma	11
2. Acute nephritis	7
3. Chronic nephritis	16
4. Tuberculosis	88
5. Pyelitis, Pyelonephritis, Pyonephrosis	132
6. Foreign body (calculus)	64
7. New-growth (malignant)	12
8. Congenital	11
Horseshoe kidney: 3	
Double pelves (infected): 8	
9. Cystic	3
Ureter	
1. Foreign body (calculus)	87
2. Inflammation (stricture)	1
3. Congenital	
Double ureter with calculus and infection	2
Bladder	
1. Trauma	6
2. Acute and chronic inflammation	38
3. Diverticula	4
4. Foreign body (calculus)	39
5. New-growth	
Malignant and benign	87

[1] Read at the joint meeting of the Maine and New Brunswick Medical Societies, Houlton, Maine, June 6, 1923.

Prostate	
1. Actue inflammation	10
2. Chronic inflammation with tuberculosis	39
3. Foreign body	2
4. Prostatism	54
5. New-growth, malignant	14
Urethra	
1. Trauma	13
2. Acute inflammation	11
3. Chronic inflammation	15
4. Stricture of urethra	10
5. Foreign body	1
6. New-growth, benign (caruncles)	10
Unclassified as to etiology	34

An analysis of these 821 cases shows that 192 were due to calculi, 113 to tumors, 88 to renal tuberculosis, and 143 to surgical infections of the ureters and kidneys; or, excluding the urethra, 536 cases out of 761, that is over 70 per cent were caused by calculi, tuberculosis, cancer or surgical lesions of the kidney; while the other 30 per cent most certainly required investigation. The great importance of subjecting these patients to a careful and thorough examination is at once apparent. With the present day methods of diagnosis, the origin and cause of urinary hæmorrhage can be ascertained in a very large percentage of cases. Indeed, the regular routine urological examination will shed much light on all such cases. The findings given in the preceding table cannot fail to impress us with the fact that red blood cells have no place in normal urine, and that they are caused by some pathological condition which it is our duty to discover.

Lantern slides demonstrating the classification and one of each of the surgical conditions mentioned were shown.

CONGENITAL DIVERTICULUM OF THE COMMON BILE DUCT

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THIS condition, sometimes erroneously called congenital cyst of the common bile duct, is one of considerable rarity. Although its symptomatology is characteristic and its treatment is by now standardized, most of the cases have been unsuccessfully treated, because the surgeon was unaware of the existence of the condition with which he was unexpectedly confronted. It is well, therefore, that the cases should be recorded as they occur, in order that the disease may be borne in mind, and perhaps some light thrown on its origin.

The case to be described is somewhat unusual in two respects, first, in that there was present a definite narrowing of the intrapancreatic portion of the common bile duct, and second, in that the patient was of the male sex.

The patient, Chi Tung-Sheng, a Chinese boy aged 15, was admitted to hospital on July 28, 1923. His family history contained nothing of importance. He was married, but had no children. In childhood he had had measles and smallpox. He stated that he frequently passed round worms in his stools.

Since he was a small child he had noticed that his skin was slightly more yellow than is usual in his race. Five months ago his eyes became yellow, and at the same time the whole of his body was similarly affected. His skin itched, and small, raised, red spots appeared on his legs. After the jaundice became more marked, he noticed a lump in the right side of his abdomen. During the last month the jaundice has markedly increased, and his stools have been grey in color. More recently still, the stools have been loose and frequent. Once or twice they have been black. He complains of a little occasional abdominal pain which bears no relation to food. As far as could be ascertained, it was neither acute nor colic-like, and did not appear to disturb him much.

His appearance was that of a well made boy of fifteen; he was a little thin, seemed weak, and rather listless. Beneath the first, second, and third finger nails of each hand were hæmorrhages; most marked on the first finger, less so on the second finger, and quite small on the third. The outline of these hæmorrhagic areas was quite symmetrical on both sides. The only other physical signs of disease were those of a tumor in the right upper abdominal quadrant. The abdominal wall was bulged forward by a round mass about the size of a fetal head. It was tense and elastic to palpation, dull on percussion, and moved slightly with respiration. Its respiratory excursion was not so great as that of

a distended gall bladder. Examined bimanually, slight fluctuation could be obtained. The upper border of the tumor was beneath the liver; its lower border reached down as far as the umbilicus; mesially it just crossed the middle line. It did not bulge into the flank but could be palpated therefrom. No band of resonance corresponding to the colon could be detected crossing it transversely. The liver was not palpable.

While in hospital the patient's temperature was between 99 and 100; his pulse was 80, full and strong. His urine contained bile. His blood contained 4,030,000 red cells and 7,120 white cells per cubic millimeter. Hæmoglobin, 50 per cent. The coagulation time was 12 minutes, and the Wassermann reaction negative.

His stools were grey, contained no ova, no amœbæ, and no excess of fat. Several diagnoses were suggested. Among these was the correct one, which was rejected because of lack of familiarity with its symptomatology. A blockage of the cystic and common ducts by round worms was thought to be a possibility, since they are so extremely common in this country, and were present in this patient. It was however obvious that laparotomy was imperative. This was done after 3 days' preparation, consisting of a daily intravenous injection of 5 cubic centimeters of a 10 per cent solution of calcium chloride. He was fed on forced fluid up to 4,000 cubic centimeters daily, and was given as much glucose solution per rectum as he could absorb. It was noticed at operation that his coagulation time was considerably reduced.

The patient was given an injection of 1/100 grain hyoscine and 1/6 grain morphine 1 hour before operation. A smaller dose of the same combination of drugs was given again after half an hour.

The abdominal wall was infiltrated with 1 per cent novocain, and a right external rectus incision was made through the skin and anterior rectus sheath. The muscle was displaced mesially, and the posterior sheath and peritoneum infiltrated widely with novocaine.

When the abdominal cavity was opened a small quantity of free fluid escaped, and was mopped up. A rapid examination revealed the following condition of affairs:

The right hypochondrium was filled up by a tense round cyst about the size of a fetal head. From over its upper edge protruded the gall bladder, which was apparently normal in all respects. The liver was a little congested but to the naked eye showed no signs of cirrhosis. On its anterior and inner aspect, the cyst was crossed transversely by the pyloric portion of the stomach and the first part of the duodenum. The descending portion ran downward and slightly inward. When the lower part of the incision was retracted, the hepatic flexure of the colon could be seen on the lower and mesial aspect of the cyst. Above the pylorus the foramen of Winslow was stretched tightly over the cyst, and into it a finger could be inserted with difficulty. Laterally

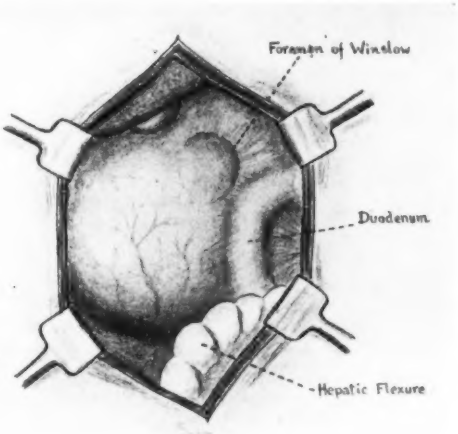

Fig. 1. Condition found in patient.

the cyst wall was covered by peritoneum which was reflected off the lateral aspect of the duodenum and stomach. The condition is illustrated in Figure 1. A short incision was made in the peritoneum parallel to the duodenum.

The peritoneum was easily stripped from the lateral wall of the cyst, and below it the kidney could be felt. It was not possible to dissect the duodenum from the anterior aspect, nor was any serious attempt made, as the diagnosis was by this time clear.

During the stripping of the peritoneum and exploration of the relations of the cyst, there was a good deal of trouble with oozing. It should be noted here for future guidance, that such a procedure was a mistake and should not be done under any circumstances. Isolation of the cyst and its removal, after tying some kind of pedicle, although it has been done, necessarily results in the death of the patient. The oozing caused by attempts at enucleation may be a material factor in prognosis for a jaundiced patient.

Packs were now inserted into the abdomen, and the cyst tapped. The fluid withdrawn was chocolate colored and contained altered blood, bile pigment, cholesterin, and a few pus cells. The opening was then enlarged, the cyst wiped out, and the interior inspected. No openings of any kind could be seen. The head of the pancreas could be felt through the cyst wall by using one finger inside, and another to press down from the outside. Nothing could be felt in the intrapancreatic part of the common bile duct. The opening was sewed up partly, and partly used to make an anastomosis between the cyst and the duodenum adjacent to it. This was easily done by using clamps and a double layer of fine catgut. The suture line was reinforced by a few separate interrupted sutures. The opening in the peritoneum was

sewn up, and the abdomen closed in the usual way. A small drain was left down to the anastomosis. This was removed next day.

The whole operation lasted 1 hour and 10 minutes. A large part of the time was consumed in tying off many tiny bleeding points both in the abdominal wall, and the retroperitoneal space which had been opened up while exploring the relations of the cyst.

The boy stood the operation very well, his pulse at the finish being 92. Up to the time he died it was never above 105 beats to the minute.

On the morning of the third day after operation, the patient suddenly collapsed and died. A complete postmorten could not be obtained, but the operation wound was opened up and the cyst was removed together with the liver, pancreas, bile ducts, and duodenum. There was no peritonitis, and no bile in the peritoneal cavity. The anastomosis was firm. On opening the peritoneum over the cyst, the retroperitoneal space was found all blood stained and a clot about the size of an orange was present. The condition, then, was that commonly seen in patients dying after operation for the relief of long-continued biliary obstruction. The hæmorrhage present was not enough to account for the patient's death, which was probably due to cholæmia.

The liver was normal in size, but rather congested. Section showed no cirrhosis, but the smaller bile ducts were rather distended. The gall bladder was to the naked eye normal; it contained about an ounce of a slightly yellow mucoid secretion. The cystic duct was not dilated; it opened into the cyst wall by a round opening situated in its upper and outer part. Its last inch and one half seemed to run in a groove in the cyst wall, from within outward. After some search, the openings of the hepatic and common ducts into the cyst were found situated about 2 inches apart, on the posterior cyst wall. They were guarded by two semilunar valvular folds, the cavities of which faced one another, and were formed by pressure on the anterior boundary of the duct as it entered the cyst. The cyst was lined by biliary epithelium, and its walls were composed of fibrous tissue. The hepatic duct was normal, but the lower end of the common duct showed an interesting state of affairs. The cyst had involved the common duct nearly up to its intrapancreatic portion. Some difficulty was experienced in getting a probe along it, both from the cyst and from the duodenum. When this was accomplished and the duct slit up, it was seen to be narrowed just proximal to its joining with the pancreatic duct. Its circumference above this constriction was 13 millimeters, and that of the constricted portion was 5 millimeters. The duodenal opening was apparently normal in size and position. The accompanying diagram shows the condition better than any description (Fig. 2).

This condition, as has been said already, is very uncommon. In 1917 Erik Waller (1) collected all the cases recorded up to that time. There were 35 including his own. In 1920 McConnell (2) reported one case; since then Kremner (3), Budde (4), Reel and Burrel (5) have reported one each. Morley (6) has added two more to the list, thus making a grand total of 42, including the one here described. At the end of Waller's paper there is a complete bibliography of the condition up to date.

Briefly stated the salient etiological and clinical features of the disease are as follows:

The average age at which symptoms first appear is 13 years. The youngest patient, a child of 5 years, reported by Oxley (7), had had symptoms from birth. In the case here described the patient said that he had always been a little yellow, so perhaps the same may be said of it; but the Chinese are notoriously bad observers of clinical phenomena. The oldest patient on record, that of Reel and Burrel (8), was a woman, age 56, who had noticed the presence of a tumor for 20 years.

As far as sex is concerned, the disease predominates in the females to the extent of 85.5 per cent, and only 6 cases have been recorded as occurring in boys. We have as yet no explanation of this peculiarity.

There is no evidence that heredity plays any part in the causation of this condition. One of Morley's cases gave a family history of jaundice. The patient had had three sisters all of whom had died within the first month from jaundice. Unfortunately no postmortem examination was made on any of them.

If the existence of the condition is borne in mind, the clinical picture should in all cases be sufficiently clear to enable a diagnosis to be made without difficulty. The outstanding features are three, namely, pain, tumor, and jaundice. Wasting may sometimes be present, but is by no means constant. Should a female child present these three symptoms, it should arouse strong suspicion on the part of the doctor.

The pain is usually acute, intermittent, and colic-like in type. It may be severe enough to make the patient double up in bed; on the other hand it may be dull and aching, or it may only amount to mild discomfort. One of the patients had no pain at all, and in the case here recorded there was very little pain. But by far the large majority of pa-

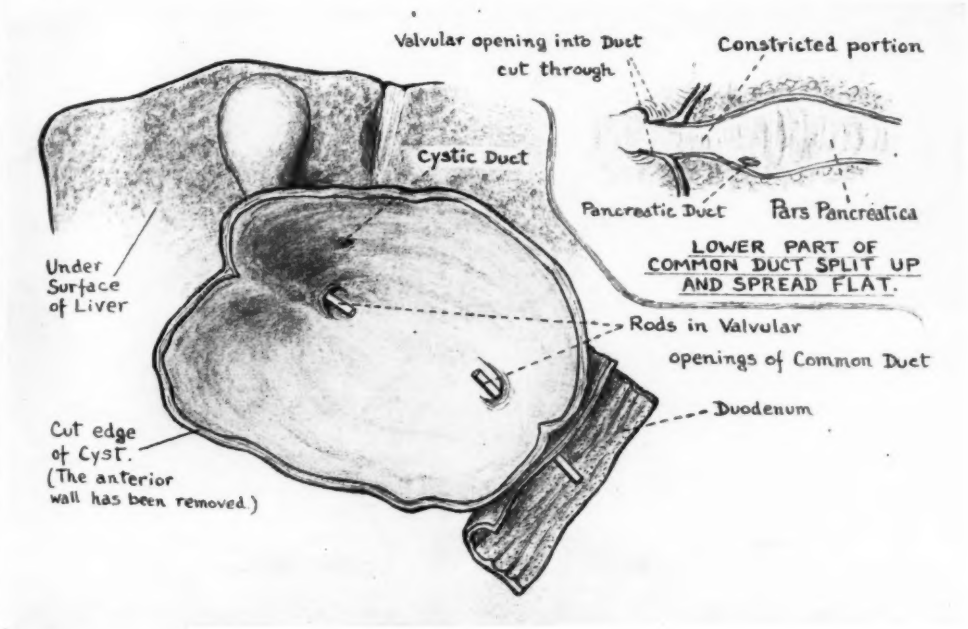

Fig. 2. Drawing of postmortem specimen.

tients have acute colic-like pain which may be the initial symptom, antedating the others by many months.

Vomiting is not constantly present. It may accompany very severe pain, and in one case appeared to relieve the pain. In the latter case Morley (9) suggested that the vomiting was due to chronic duodenal ileus, caused by pressure of the cyst, forward, on the root of the mesentery and the superior mesenteric vessels.

The tumor varies in size; it may be large enough to be mistaken at first sight for a pregnant uterus or an ovarian cyst. In Waller's case it was about the size of a fist, but most commonly it is about the size of an ostrich egg or fetal head. It is rounded, tense, and not very tender. On percussion it is dull, and the upper limit of its dulness merges into that of the liver. Unless very large, it moves slightly on respiration, but its respiratory excursion is not so great as that of a distended gall bladder. It was noticed once that after the ingestion of food the cyst underwent painful contractions and increased in size.

The degree of jaundice also is variable. It may be intermittent and scarcely ever noticed by the patient, or it may be complete and remain so for some time. However, the amount of jaundice does not vary with the size of the cyst. In one case in which the cyst was taken for an ovarian cyst, the patient had only slight jaundice. Slight jaundice may date back many years.

Of these three characteristic symptoms, either one may usher in the disease, or may be that from which the patient demands relief. The patients, therefore, tend to fall into one of three groups:

(1) They may be referred to a gynecologist for the removal of a large abdominal tumor; (2) they may be seen in the medical out-patient department complaining of pain and jaundice, or (3) they may come to the surgeon with an acute abdominal condition accompanied by great pain, tenderness, fever, and vomiting.

If one is aware of the condition, the diagnosis is not difficult. A tumor in the right hypochondrium is very uncommon in children.

It should not be difficult to differentiate the condition from an enlarged gall bladder, by its shape and comparative fixity, and from a pancreatic or liver cyst by its position. When the cyst is very large, and there is no jaundice, the difficulties must be great. A careful inquiry into the history for slight jaundice, and for information as to where the tumor originally arose, may throw light on the case.

As has been said, treatment in the majority of the recorded cases has not been very successful. On three occasions the cyst has been removed, resulting, of course, in the death of the patient. Five patients died after operation from violent hæmorrhage, coming either from the cyst wall, or, as in one case, from the stitches. Of 22 cases in which drainage was employed, only three survived. One of these had a permanent fistula and died later of pulmonary tuberculosis. The remaining two were alive and well at the time of publication. One patient had three operations. The first consisted of simple drainage. The second time the cyst was again drained as an abscess had formed within it; and at a third operation designed to drain the cyst permanently by making an anastomosis between it and the duodenum, it was found that, as the result of the inflammation, the cyst had so shrunk that any such procedure was impossible. The third patient was alive and well one year after operation but had a small constantly discharging fistula. In this group of cases there were many unsuccessful secondary operations.

Primary drainage followed by anastomosis, or laparotomy with this object in view was done in eight cases. Of these patients five recovered, and three died. It may be inferred from a perusal of the reports of these cases, that a secondary anastomosis following drainage may be an extremely difficult if not impossible procedure.

A primary anastomosis between the cyst and the duodenum is obviously the operation of choice, although in severely jaundiced patients, primary drainage may be a wise preliminary step. Two have recovered and two died, of the four patients in whom this has been done. In one of the fatal cases, the cyst was drained externally at the same time; in the other, which is here reported, it is probable that the patient's condition had more to do with his death, than the choice of operation.

The etiology of the disease is still very obscure. From a consideration of the morbid anatomy it is quite plain that once a diverticulum is present, nothing will prevent the further development of the condition. The hepatic and common bile ducts are situated within a short distance of each other at the bottom of the diverticulum. As this fills up with bile and enlarges, it will tend to press downward on and at the same time overlap the ducts as they enter and leave the cyst, making the opening valvular in form, so that the larger the cyst, the greater the obstacle to outflow on the part of its contents.

When, as occurred in this specimen, the disease has progressed far enough to render the duct openings flattened, crescentic, and valvular, it is difficult to see how the cyst ever emptied itself at all. Postmortem, it took a detailed search before the openings were found, so inconspicuous were they.

Having explained the growth of the diverticulum, and in part, the origin of the symptoms, we will consider how it originally arose. The first and most obvious explanation of a dilated duct is obstruction below the dilatation. Now, although obstruction to the common duct does sometimes produce considerable dilatation, it is not of the type seen here, or described in other records of the condition, but is cylindrical or spindle-shaped. Here we are not dealing with a generalized dilatation of the bile tract, but with a local diverticulum of varying size, involving fairly constantly one particular part of the tract, viz., the hepatic and supraduodenal portions of the duct, the cystic duct opening into the wall of the diverticulum. Moreover in nearly all the postmortem records, obstruction has been conspicuously absent. In some cases it has been noticed that the entrance of the common duct into the duodenum was abnormally placed, and in this case there was narrowing of the intrapancreatic portions of the duct. This narrowing was not sufficient to prevent the outflow of bile, but might conceivably have assisted in raising the intraductal ten-

sion, and have thus been a contributory factor in the development of the diverticulum. The same may possibly hold good with regard to abnormal insertions into the duodenum; so that in our search for a first cause we must go further back still. In 1910 Heiliger (10) found at autopsy a small cyst of the common bile duct in an almost mature fetus. It had caused no obstruction and bile was present in the intestine. This gives us some proof that the condition may be congenital, and a study of the development of the biliary tract provides us with still more evidence.

Stimulated by increasingly frequent surgical exploration of the gall bladder and its ducts, recent research has amply demonstrated that the development of the biliary apparatus is not the standardized, fixed procedure we formerly supposed it to be. Abnormal development is, as the result of unfortunate experience, better known to surgeons than to anatomists, and usually consists in variations in the junction of the cystic and hepatic duct, and their relationship to the surrounding blood vessels. Such variations are embarrassingly common. Most of the observations have been made post-mortem, or in the dissecting room, but a study of the embryology of this region amply confirms these findings.

In a 22.8 millimeter embryo from the Harvard Collection (Series 871), the common bile duct is double, and the two cavities unite to form a single lumen proximally and distally. Lewis, in his article in Keibel and Mall's *Human Embryology* (11), states that rudimentary and additional ducts are common in human embryos. They may join the cystic, hepatic, or common ducts, but usually occur near the junction of all three. In Thyng's (12) model of a 7.5 millimeter embryo, there is a small bud representing an adventitious duct, just at the junction of the hepatic and cystic ducts. It does not reach the liver. Similar outgrowths have been described in 9.4- and 10-millimeter embryos (13), and detached nodules of epithelium have been found in two other embryos, 14.5 and 16 millimeters, respectively (14). Although these developmental anomalies seem to be common in human embryos, they are infrequent in the fetal and adult stages. As has been said here, the common irregularities are in the relationships of the ducts. It would seem, therefore, that the developing biliary system has unusual powers of returning to the normal, in spite of early departures therefrom, or that its normal development is not completely worked out.

Aberrant ducts, diverticula and detached nodules of epithelium can be absorbed, but it is possible that, if there is any small obstruction to the outflow of bile or other abnormal developmental stimuli, the small outgrowth may be encouraged to persist and enlarge. Such an outgrowth as is shown in Thyng's model and elsewhere described would, if canalized and enlarged, easily account for the formation of the condition under discussion.

To sum up, we have a condition which is obviously neither inflammatory nor neoplastic in origin, but there is evidence enough to allow us to assume that it is due to the persistence in adult life of some developmental abnormality. The occasion of this persistence may in some cases be the raised tension in the bile ducts.

I am indebted to Dr. F. H. Mosse for the opportunity to operate on and report this case. He has also drawn the diagrams which accompany the text.

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TUBERCULOUS CYST OF SPLEEN: SPLENECTOMY: RECOVERY[1]

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Surgeon to the Roosevelt Hospital

PRIMARY tuberculosis of the spleen is a condition uncommon enough to warrant recording as cases are observed.

At the Roosevelt Hospital we have recently operated upon such a case which presented some unusual features; notably, the size of the spleen, the extent of destruction of splenic tissue with the capsule still intact, and the very mild degree of constitutional reaction.

In classifying the case as primary tuberculosis of the spleen, we mean simply that there was no clinical evidence of other tuberculous lesions which might have assumed the rôle of a primary focus except tuberculous lymph nodes of moderate size and chronic type though we are, of course, unable to state definitely that no such focus existed.

The patient was a native of Antigua, B.W.I., colored, 26 years of age, married, laborer. He had lived in the United States since 1920. He was admitted to the Roosevelt Hospital on November 15, 1922, to the Medical Service, Dr. Evan Evans, attending physician. The condition which brought him to the hospital was not the splenic condition, but a loss of sexual power for which he sought treatment.

A gradual enlargement of the abdomen had been noticed for about 4 months. He had no real pain, but recently began to have discomfort over the left upper abdomen and lumbar region. Exacerbations of moderate pain in this region occurred in April and October, 1922. He had some shortness of breath on exertion of late, occasional slight cough, and was subject to "colds."

He was said to have had yaws when 8 years old; Neisser infection 5 years ago; questionable chancre 6 years ago. No history of chronic illness.

Physical examination showed good general physique and nourishment. The cardiac and pulmonary signs were normal; slight enlargement of cervical, axillary, epitrochlear, and inguinal lymph nodes; no periosteal nodes; reflexes normal; eyes normal.

A large mass fills the left upper abdomen; it extends 2 centimeters beyond the mid-line to the right; downward to the level of the iliac crests; it has the general position and shape of the spleen; its surface is smooth, edges hard and rounded; center soft and fluctuating. It moves slightly with respiration; is not tender; the greatest circumference of the abdomen is 84.5 centimeters.

The liver edge is felt 3 inches below the costal margin; seems normal and is distinct from the mass. There is no evidence of ascites. Weight 149½ pounds, blood pressure 103/78; hæmoglobin, 65 per cent; red blood corpuscles, 4,350,000; white blood corpuscles, 8,000; polymorphonuclears, 85 per cent; eosinophiles 2 per cent; Wassermann, 4 plus.

The blood chemistry was normal. The urine showed a trace of albumin, a few casts at times; and was otherwise negative.

November 15, 1922, the temperature was 97 to 100.8 degrees; later it was normal most of the time. Pulse and respiration were normal.

Antiluetic treatment (not salvarsan) was given. There was no diminution in the size of the spleen; nor change in symptoms or signs. The X-ray showed the descending colon pushed away to the right by a mass; otherwise the abdominal picture was negative. The X-ray of the chest was negative.

The cervical lymph node removed for diagnosis showed chronic tuberculosis. He was transferred to the Second Surgical Division on December 7, 1922, and splenectomy was performed on December 9, through a longitudinal incision at the inner third of the left rectus. The mass proved to be a huge cystic spleen, very adherent to surrounding structures. The lower pole and body of mass were first freed and delivered; and adhesions were clamped and ligated as the operation proceeded. The upper pole was firmly adherent to the diaphragm and the splenic flexure of the colon; the dense adhesions were separated and divided partly by sharp dissection and with great difficulty. During the dissection a large locule of the cyst at the upper pole ruptured, and curdy, yellowish-white material escaped. The mass was finally freed except at its pedicle, and a large gauze pack filled the hugh space beneath the diaphragm. The vessels of the pedicle were comparatively small and were secured without difficulty, and the mass removed. After careful hæmostasis, the wound was closed without drainage. There had been no damage to adjacent viscera, and comparatively little loss of blood.

The time of operation was 1 hour, 45 minutes, condition poor. An infusion of 700 cubic centimeters of salt solution was given on the table, followed by a transfusion of blood of 448 cubic centimeters on his return to the ward. His condition was critical for the first 2 or 3 days after which the convalescence was uneventful. The wound healed *per primam*. The temperature ranged from normal to 102 to 103 degrees for 20 days postoperative, finally remaining normal after the twenty-fourth day.

He was discharged on January 3, 1923, 25 days after operation.

[1] Read before the Southern Surgical Association, December 12, 1923.

Fig. 1. Tuberculous cyst of spleen. Dimensions: 29 by 18.5 by 15 centimeters. Diameter of large cyst 11 centimeters. Weight, 3,270 grams.

GROSS SPECIMEN

The removed spleen was enormous in size. The lower two-thirds was occupied by a huge cyst locule filled with a jelly-like material, the locule at the upper pole ruptured in removal being much smaller; a very little thinned out splenic tissue remained in the septa between the locules; hardly any at the periphery.

Its dimensions were 29 by 18½ by 15 centimeters. Its weight was 3,270 grammes, 16 pounds, 13 ounces after the loss of the semifluid content of the upper locule of the cyst.

The large cyst measured 11 centimeters in diameter.

Only 3 cases of equal or larger size have been recorded, all being autopsy, and not operative cases.

Microscopic Sections. Sections showed no typical tuberculosis nor other characteristic lesion. A probable diagnosis of tuberculosis was made on the gross pathology.

Animal Inoculations. A guinea pig was inoculated with contents of cyst on December 9, 1922. The autopsy on January 8, 1923 (30 days) showed general miliary tuberculosis.

Winternitz in 1912 reported a collected series of 51 cases of primary tuberculosis of the spleen, of which 34 were autopsy findings and only 17 operative. Of the 17 operated upon, 10 recovered and 7 died.

Royster operated upon a case successfully in January 1911. Giffin in 1919 reported a case of successful splenectomy (weight 508 grams); the patient was reported well 2 years after the operation. He also adds a case of successful splenectomy (weight 625 grams) for secondary tuberculosis of the spleen, with a healed pulmonary lesion at the right apex, well 2 years and 4 months after operation.

Giffin also reports two interesting autopsy cases, one with blood findings simulating pernicious anæmia, and one with leukæmia, in both of which the spleen showed extensive tuberculosis.

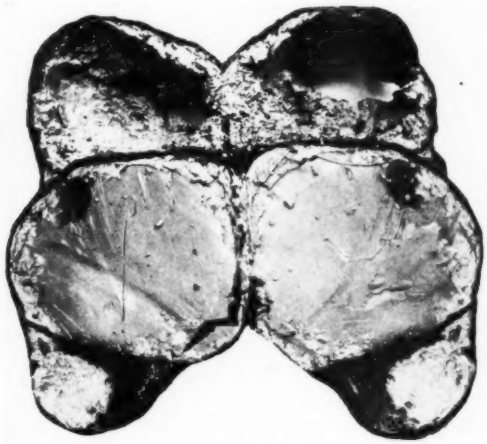

Fig. 2. Spleen bisected and laid open.

The careful and thorough review of Winternitz brought out many interesting facts relating to the condition.

Fig. 3. Patient 9 months after operation.

The age by decades of 45 of the 51 cases in the series was,

First decade—5 cases	Fifth decade—6 cases
Second decade—3 cases	Sixth decade—2 cases
Third decade—12 cases	Seventh decade—5 cases
Fourth decade—10 cases	Eighth decade—1 case

Examination of the blood was made in 26 cases. It was normal in 9; moderate secondary anæmia was present in 11, and there was a definite polycythæmia in 6, the red cell count ranged up to 8,000,000 or more. The leucocytes were not generally increased.

Other authors have noted the tendency to polycythæmia in tuberculosis of the spleen. Douglas reported a marked instance in a man of 39 years of age, the red cell count running as high as 8,800,000. Death occurred 9 days after splenectomy.

Of the 6 cases of polycythæmia cited by Winternitz, 4 were autopsy cases; in one the result was not stated; and one (6,000,000 red blood cells) recovered after operation.

Splenectomy in the polycythæmia of Vaguez disease, is generally fatal or fails to arrest the disease and is contra-indicated (Moynihan). The weight of the spleen in 31 recorded cases was as follows:

Cases	Grams	Cases	Grams
8	150 to 500	7	1500 to 2000
5	500 to 1000	2	2000 to 3000
6	1000 to 1500	3	3000 to 4000

As previously stated the 3 cases of over 3,000 grams were all autopsy cases.

Lymph nodes examined in 35 cases showed no clinical enlargement in 29 (82.8 per cent).

The prominent symptoms in most of the cases were splenic tumor, and pain in the splenic region.

The course was chronic in a majority of the cases, rapidly progressive in a few.

SUMMARY

Primary tuberculosis of the spleen though rare, is a distinct entity, and is curable by operation in favorable cases. Without splenectomy a fatal termination is inevitable.

Splenectomy is indicated in certain cases of secondary tuberculosis of the spleen, when the splenic lesion is predominant and the supposed primary lesion is a healed tuberculosis or susceptible of cure.

Giffin's case is an example of this condition. Polycythæmia occurs in a certain percentage of cases and probably adds to the gravity of the prognosis, but does not contra-indicate operation when the splenic tuberculosis is the dominant factor in the case. The prospect of a complete cure and restoration to health in patients surviving splenectomy is demonstrated by several of the reported cases.

INFECTIONS OF THE HAND[1]

By JOHN H. GARLOCK, M.D., New York

THE following paper embodies an analysis and a report of the end-results of 460 consecutive infections of the hand seen in the private, clinic, and hospital practice of the writer. From the very beginning of this study, Kanavel's monograph on hand infections was used as a standard. As the number of cases studied increased, it became evident that we were gradually laying more and more stress on apparently minor details, especially in the methods of diagnosis and the operative and postoperative management of the fascial space and tendon sheath infections. We have often been impressed with the fact that close attention to distribution of the swelling and the areas of redness, the interpretation of the patient's subjective complaints, etc., makes for a more accurate and rapid diagnosis. The intelligent management of the more severe hand infections presupposes a complete familiarity with the minute anatomy of the hand and forearm and a thorough understanding of the various pathological processes that may exist and their possible paths of extension.

In this group of 460 cases has been included every case of hand infection irrespective of its mild or severe character. In a number of instances, the cases are discussed two or three times under different headings. For instance, an infection of the thumb flexor tendon sheath which has extended and involved the radial bursa will be discussed under those separate headings.

SIMPLE ABSCESSES AND CELLULITIS

This group comprises 97 cases, or 20.4 per cent of the total series. It includes simple abscesses occurring in various parts of the hand, isolated abscesses in the web spaces, i.e. those not due to a pre-existing lumbrical space infection, and cellulitis of the digits and hand proper. It was noted that abscesses were most commonly seen on the dorsal and ventral aspect of the proximal and middle phalanges and on the dorsum of the hand. As a rule, these infections are readily recognized. However, on four or five occasions we have seen deep localized infections over the anterior aspect of the middle or proximal phalanx which, on casual examination, might have been mistaken for a tenosynovitis. In these instances, it was demonstrated that the region of tenderness was fairly well localized, the swelling and area of redness were confined to the parts adjacent to the point of maximum tenderness, and there was considerable active and passive mobility in the finger. In 2 cases there was tenderness along the course of the tendon sheath with some pain on hyperextension of the finger, but the general appearance of the finger and hand and the presence of some active motion seemed to militate against the diagnosis of tenosynovitis. Incision showed collections of pus in the subcutaneous tissues immediately overlying the sheaths. The proximity of the infection to the tendon sheath probably was the etiological factor in the aforementioned so-called positive signs of tenosynovitis. There were 72 cases in this group and they were treated by either simple or crucial incision, depending on the extent and virulency of the infection. In every instance the primary incision controlled the infection and the end-result was devoid of any permanent defect.

There were 8 isolated web-space abscesses and they were all caused by puncture wounds. The physical signs were quite distinctive, consisting of marked localized swelling of the entire web area, extending on both the dorsal and ventral sides, considerable redness limited to the web, separation of the contiguous fingers and œdema of the dorsum of the hand, confined mainly to the immediate neighborhood of the infection. Slight pressure over either side of the web caused pus to exude from the punctured wound. Treatment consisted in making an adequate linear incision over the point of maximum tenderness. In 3 cases we found it necessary to split the entire web from front to back in order to secure adequate

[1]Submitted for publication, November, 1923.

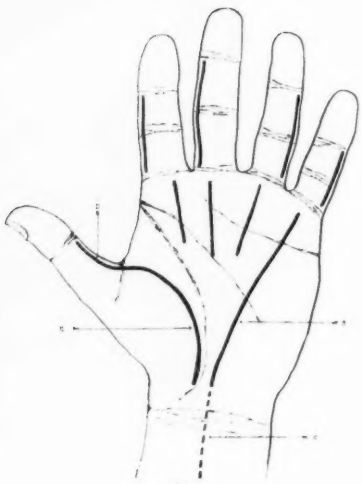

Fig. 1.

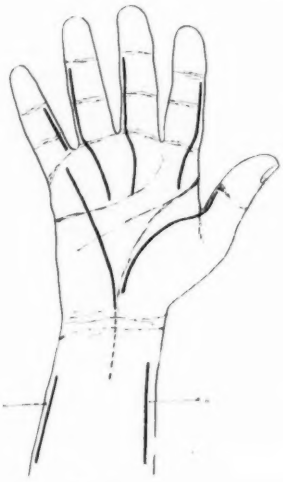

Fig. 2.

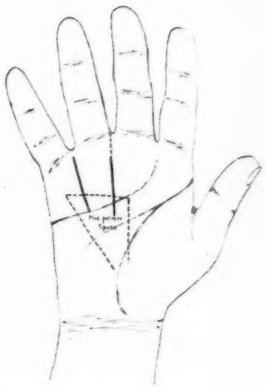

Fig. 3.

Fig. 1. A diagram representing the segmented incisions used to drain suppurative tenosynovitis of the fingers. *A*, Prolongation of incision to expose the palmar portion of the ulnar bursa. *B*, Prolongation of thumb incision to drain the distal part of the radial bursa. *C*, Continuation of incision *A* used occasionally to split the anterior annular ligament. *D*, This incision is meant to be represented as starting more toward the inner side of the proximal phalanx.

Fig. 2. Diagram representing the continuous incisions used to drain suppurative tenosynovitis of the fingers. It seems that segmented incisions sketched in Figure 1 drain just as efficiently in a large number of cases and apparently shorten the period of convalescence. *A*, External lateral incision above the wrist used to drain the upper prolongation of the radial bursa. *B*, Internal lateral incision used in exposing the upper end of the ulnar bursa.

Fig. 3. Diagram indicating the anatomical position and limits, projected to the surface of the hand, of the middle palmar space with the incisions used to drain it.

drainage. No untoward sequelæ followed this procedure. Figure 1 represents a case where two adjacent web spaces were split in this way. The photograph was taken 4 days after the operation and indicates the rapid recovery when an adequate primary incision is made. The end-results in this group were universally good.

In the cellulitis group, comprising 17 cases, are included those cases of localized lymphatic infection occurring in the skin and subcutaneous tissues of the digits and hand proper. They are of interest chiefly from the standpoint of differential diagnosis. In most cases it is impossible to elicit any history of injury preceding the beginning of the infection. The patient notices that the part involved, usually a finger, begins to swell and appears inflamed. The entire digit soon assumes alarming proportions and a uniformly pinkish color. We have found that the objective findings are usually out of all proportion to the subjective complaints. There is, as a rule, some dull pain over the whole part involved but it is not of the intense throbbing type so characteristic of pus under tension. On examination it is found that tenderness is universally distributed and cannot usually be localized to one definite point. Motion in the various joints is good. A noticeable characteristic is that the part lacks the induration indicative of a localized collection of pus. None of the typical signs and symptoms of tendon sheath or fascial space infection can be elicited. Very often the red streaks of lymphangitis are seen over the inner aspect of the forearm and arm. This was noted in 10 of the 17 cases in this group. None of these patients showed any marked

Fig. 4. Diagram made to indicate the various incisions used to drain deep abscesses of the forearm.

Fig. 5. Double web space infection due to an abscess over the front of the metacarpophalangeal joint of the left middle finger. The webs were split from front to back. The associated lumbrical canals were also involved. These photographs were taken on the fourth postoperative day and indicate the complete function at this early date.

systemic reaction. Under conservative treatment, consisting of warm boric acid or saline wet dressings, these infections subside in a surprisingly short time. The following case is illustrative of this group:

Mr. W. B. L. was referred for operation with the diagnosis of suppurative tenosynovitis of the flexor tendon sheath of the right ring finger. There was no definite history of any injury to the part. Two days before, he began to experience a dull pain in the right ring finger, accompanied by considerable swelling of the entire digit. The pain was constant and was characterized as a dull ache. Examination showed that the whole finger was of a deep pinkish hue and was uniformly swollen on all aspects. No definite point of tenderness was demonstrated, although the whole finger was distinctly sensitive to touch. The dorsum of the hand was slightly œdematous. A faint red line was seen running up as far as the epitrochlear region. Temperature, 100.5 degrees F., pulse 90. The hand was treated with warm saline wet dressings, coupled with eliminatives and rest in bed and, 48 hours later, there was a complete subsidence of the subjective and objective symptoms.

In two cases an error in diagnosis was made, with resultant incision and exploration. Both

Fig. 6. Suppurative tenosynovitis of the little finger. Pus cultured staphylococcus hæmolyticus. Patient was operated upon approximately 36 hours after onset of symptoms. Wound of entry was a small laceration on the dorsum of the middle phalanx. Tendons did not slough. Patient insisted on leaving the hospital before wound was healed and did not report for further treatment. Photographs show the deformity due to marked contraction of the scar. There is however slight active flexion. The result, undoubtedly, can be improved by a plastic operation.

patients presented what appeared to be an unusual type of cellulitis in the palm of the hand with marked local tenderness. As no improvement occurred after 36 hours of conservative treatment, it was thought best to incise. No pus was found, but it was noticed that the palmar fat was unusually œdematous, fairly flowing out of the operative wound. Following this procedure the inflammatory reaction promptly subsided. It is possible, if not probable, that a continuation of the previous conservative treatment would have caused a complete abatement of all symptoms. The result in each case of this series was a return of full function to the part involved.

SUBEPITHELIAL ABSCESSES

There were 20 cases of subepithelial abscesses, 4.3 per cent of the total series. These infections, which consist of a localized collection of seropurulent fluid of a low-grade virulency beneath the epithelium, were noted most frequently in the regions of the distal phalanx and the palm. They occurred, as a rule, in people engaged in manual labor, and considerably thickened epithelium was almost a con-

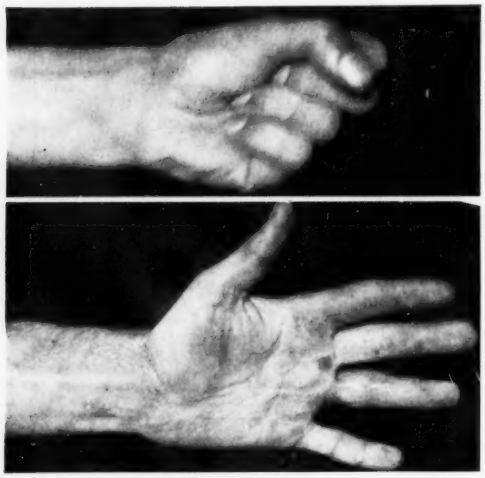

Fig. 7. Suppurative tenosynovitis of the ring finger. Patient was operated upon about 12 hours after the onset of symptoms. Small amount of turbid blood-tinged fluid in the tendon sheath culturing streptococcus hæmolyticus. Smear showed many leucocytes and organisms. Photograph shows complete function.

Fig. 8. Suppurative tenosynovitis of the flexor tendon sheath of the thumb, complicated by an arthritis in the interphalangeal joint. Pus cultured streptococcus hæmoliticus. Tendon did not slough. Distal joint became ankylosed in a partially flexed position, apparently the ideal position for the thumb in view of its important apposing action which in this case is excellent.

stant finding. In 17 cases there was very little, if any, surrounding reaction. In the remaining three abscesses, all located in the distal phalangeal region, there was marked surrounding inflammation probably due to the greater virulency of the infecting organism. First glance seemed to indicate an anterior closed space infection, but palpation gave that "feel" so characteristic of a subepithelial collection of fluid. Treatment consists in removing every part of detached epithelium and applying a dry or wet dressing as the case demands. As these infections are of minor significance, no anatomical or other impairment has ever been noted.

COLLAR-BUTTON ABSCESSES

This type of infection, the *bouton de chemise* of the French, is a definite clinical and pathological entity and derives its name from the peculiar distribution of the pus. The failure to recognize the true extent of the pathology present is a frequent cause for some unduly prolonged low-grade infections of the fingers and palm. From a pathological standpoint the cause for the distribution of the pus is to be found in the hypertrophied epithelium at site of infection, which first takes place in the subdermal tissues. As the inflammatory process extends, the pus finally burrows through the derma, producing a tiny sinus and reaches the subepidermal region where a second collection of pus is formed. The superficial appearance of these abscesses resembles strongly the subepithelial abscesses described in the preceding paragraph. On closer examination, however, it is found that there is a fairly wide area of surrounding redness and swelling. There is considerable induration at the region of maximum tenderness and the patient complains of severe throbbing pain.

In the 42 cases herein reported 13 occurred in the pulp of the distal phalangeal region, 5 over the anterior aspect of the proximal phalanges, and the remaining 24 at the distal edge of the palm. In 4 cases of the latter group, the infection had extended and the deeper pocket of pus included the adjacent webspace.

The treatment consists in removing all detached epithelium covering the superficial pocket, identifying the sinus leading to the

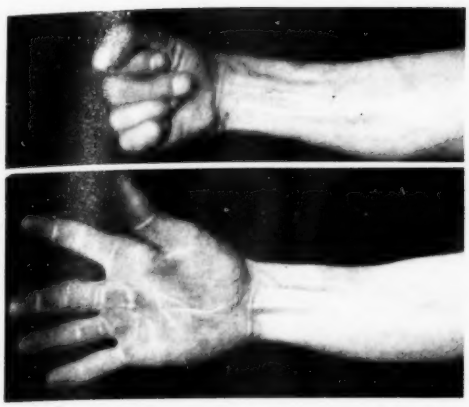

Fig. 9. Suppurative tenosynovitis of the middle finger operated upon approximately 48 hours after the onset of symptoms. Pus cultured staphylococcus aureus. There was also present a suppurative arthritis in the distal interphalangeal joint. Photographs indicate the complete functions in the two proximal joints, but complete ankylosis in the distal joint due to the arthritis. Result, fair.

Fig. 10. Suppurative tenosynovitis of the tendon sheath of the right middle finger following an extensive traumatic wound over the anterior surface of the proximal phalanx, exposing the tendons. The tendon sheath and skin were tightly sutured as a first aid dressing. Patient was operated upon approximately 50 hours after the onset of symptoms. Result: sloughing of both tendons, contracture of scar, and deformity of the finger; a poor anatomical and functional end-result. This case illustrates the scar contraction which often follows extensive infected wounds at the junction of the finger and palm.

second or deeper pocket and, with this as the center point, making either a linear or crucial incision large enough to drain the deep collection adequately.

Of the total 42 cases, 2 or 4.7 per cent presented permanent anatomical and symptomatic impairment. In both instances an appreciable part of the pulp in the region of the distal phalanx had sloughed with resultant tender deformed scars. Both patients refused plastic repair in the way of a fat transplant.

PARONYCHIA

The 40 cases of paronychia constitute 8.7 per cent of the total series. Twenty-one patients presented infections localized to one side of the paronychium. In 9 of these the infection was of the so-called acute variety and was localized entirely to the subepithelial region of the paronychium. In the remaining 12 the space beneath the nail adjacent to the paronychium was also involved. In the first type a small incision over the center of the abcess always controls the infection. In the second variety, it is safer to err on the side of radicalism than to temporize and await the appearance of the more evident signs of a typical total paronychia or "run around." An incision is made in the paronychial region to the outer side of the nail extending straight backward toward the distal interphalangeal joint for a distance of three-eighths to one-half inch. The eponychium is pushed aside with gauze and, with sharp-pointed scissors, the corner and side of the nail base is excised. To favor drainage a small strip of rubber dam or vaseline gauze is placed beneath the reflected eponychium. The results in this group were universally good.

There were 16 cases of complete paronychia or "run around." Practically all were due to neglected hangnails. In every instance operation was performed under local anæsthesia, consisting of digital nerve blocking. Two incisions are made, one on each side of the nail, as described above. The eponychium is pushed back and all detached nail is excised. No attempt should be made to remove the entire nail, unless it is already completely separated. A small strip of vaseline gauze is inserted between the eponychium and nail bed.

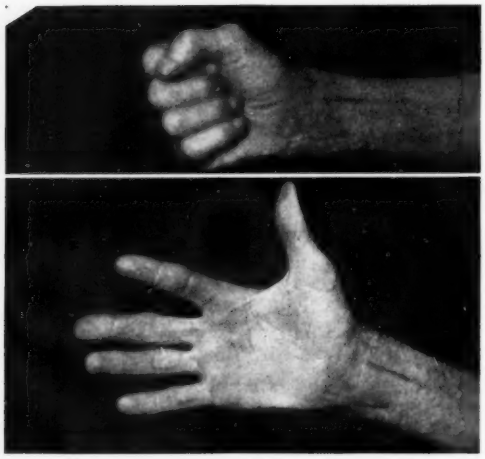

Fig. 11. Suppurative tenosynovitis of the flexor tendon sheath of the little finger with extension to the ulnar bursa. A subcutaneous collection of pus was found above the wrist. There was an abscess of the forearm behind the flexor tendon and upon the pronator quadratus muscle. The photographs show restoration of complete function in the involved parts. Cultures made from the pus showed staphylococcus aureus.

Two cases, seen for the first time after their condition had become chronic, presented fungus-like exuberant granulations extending from beneath the eponychium. In both instances the lateral incisions were made to favor drainage. One patient promptly recovered. The other, after failing to respond to ordinary treatment, recovered when a rubber band was applied at the base of the finger, producing a Bier's hyperæmia. The band was worn for 48 hours.

In this group there were three cases presenting permanently ridged nails as an anatomically defective end-result. This was due entirely to the fact that the operative incisions were not completely external to the side of the old nail, thereby resulting in injury to the nail bed.

In this group are also included three cases of infection localized to the eponychium, a condition that may be termed "eponychia." The inflammatory process does not involve the nail base or subungual region. A small curvilinear incision, made parallel to the edge of the cuticle, readily controlled the infection in each instance.

Fig. 12. Suppurative tenosynovitis of the flexor tendon sheath following traumatic amputation through the center of the middle phalanx. This photograph demonstrates continuous incision. Patient was seen 3 days after onset of symptoms. Result: sloughing of both flexor tendons, full function at the metacarpophalangeal joint due to action of lumbrical and interossei muscles.

CARBUNCLES

Carbuncles develop on any part of the dorsum of the hand containing hair follicles. Of the 38 cases, or 8.2 per cent of the total number, 19 occurred on the dorsum of the hand, more often toward the ulnar side, 16 on the dorsal aspect of the proximal phalanges, and 3 on the middle phalanges. The peculiar anatomy of the skin, with its hair and hair follicles, sweat glands and ducts, and columnæ adiposæ, is responsible for the development of this type of pathology which must be differentiated from that of simple abscess. It has been possible to do this in a great number of the cases by reason of the fact that, in carbuncular infections, one can almost always demonstrate the presence of one or more sinuses discharging pus in the area surrounding the region of central necrosis. Also, the surrounding induration is more marked and extensive. Of the 38 cases, 9 or 23.5 per cent received inadequate primary incisions because the true extent of the pathological process was not demonstrated. A crucial incision, when properly made, should always control the infection. The ends of the incisions should extend to the outside limit of the area of induration. The flaps thus formed are then raised away from the underlying tissues by incisions under the skin. Packing the wound

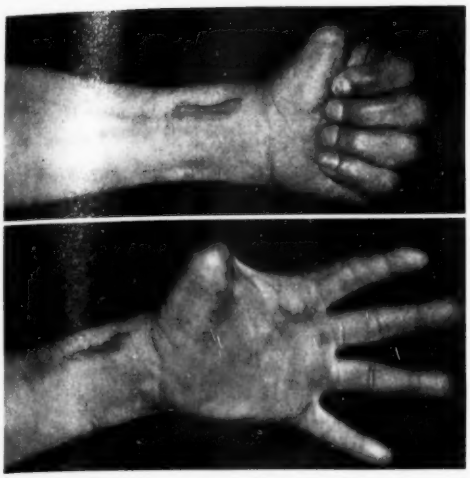

Fig. 13. Infection of the radial bursa following traumatic amputation of the thumb. Photographs indicate the position of the side incision made to drain the upper end of the radial bursa, and the complete function in the fingers. There is a normal range of mobility in the wrist joint.

Fig. 14. Infection of the radial bursa with extension above the wrist due to traumatic amputation of the thumb. The photographs show the side incision made to drain the upper end of the radial bursa and the amount of active motion present on the third postoperative day.

with gauze lifts the flaps and controls the venous ooze. The cutting away of any skin, unless grossly sloughing, is not to be recommended. We quite agree with Kanavel when he says: "The removal of any of the skin, no matter how much damaged and fragmentary, should be condemned, since one is always surprised at the rejuvenation of apparently hopelessly injured skin." As a rule, the granulating area left, after the slough has separated, epithelializes rapidly. On four occasions, where a considerable portion of the skin edges had sloughed, small skin grafts would have undoubtedly hastened recovery. The patients, however, refused to have this done. Two of them, 5.2 per cent of the entire group, presented permanent anatomical and functional disability. In one, a man of 63 years, there was 25 per cent restriction in full flexion in the metacarpophalangeal joint of the right middle finger, and, in the other, the scar was adherent to the extensor tendon of the right ring finger, preventing full flexion in the finger joints.

FELONS

Anterior closed-space infections constitute a most interesting group from many standpoints. The question of diagnosis, as to the presence or absence of pus; the anatomical position of the incision; the ultimate fate of an involved phalanx; the plastic repair of deformed scars, are a few of the numerous factors to be considered in the intelligent treatment of this form of infection. There were 62 cases, or 13.5 per cent of the entire series. Twenty-five, or 40.3 per cent of the group, were classified as localized infections not involving the entire space. In the remaining 37, this anatomically clearly defined region was more or less completely infected. From the standpoint of diagnosis, here is one condition in which the subjective symptoms are of considerable importance. There is intense throbbing pain limited to the distal phalanx. The patient complains bitterly that he has "not slept a wink for the past two or three nights." The appearance of the patient walking into the office, tenderly protecting the involved finger in the hollow of the palm of the other hand, is quite characteristic. In the early stages the entire distal phalangeal region feels tense. As the infection progresses, this tenseness becomes an induration with marked tenderness over the pulp. In a later stage the distal phalanx becomes a boggy, fluctuating mass which, by now, is more or less painless and insensitive. When the infection is localized to one part of the anterior closed space,

Fig. 15. Severe hand and forearm infection due to an incised wound over the front of the thumb. When this patient was first seen there were three incisions over the front of the forearm containing large rubber tubes leading down to the space behind the tendons; also an anterior incision draining the flexor tendon sheath of the index finger. There were signs of involvement of the tendon sheaths of the thumb, ring, and little fingers with a radial and ulnar bursitis and infection of the middle palmar and thenar spaces. These regions were adequately drained. Through side incisions a large quantity of pus was found in the deep spaces of the forearm. All the tendons with the exception of that one supplying the middle finger were found to be necrotic. This case illustrates the futility of attempting to drain deep collections of the forearm through anterior incisions and the results from delay in diagnosis. Result: a totally useless hand.

Fig. 16. Infection of the palmar fascia. The deformed ring and little fingers are the result of an old injury. The photographs indicate the free mobility of the other fingers, the scars of the various incisions made, and the ability to produce a hollow in the palm of the hand. Culture of pus: staphylococcus aureus.

tenderness is most marked at that point. A characteristic objective finding is the practically complete absence of swelling and redness in the remainder of the finger.

In that type where the pus is well localized to one part of the space, treatment consists in making an incision directly over the point of greatest tenderness. When the whole space is involved the lateral incision appears to be the best because it adequately drains the infection, it avoids the delicate tactile region of the pulp and leaves a painless scar. In a few instances, we made an incision on the opposite side, establishing through-and-through drainage. In 8 cases we were compelled to enlarge incisions which had been made elsewhere at the tip of the finger. Palmar flaps of the pulp were thus created.

Osteomyelitis of the distal phalanx occurs only when the entire space has been more or less completely involved. After a study of the gross and microscopic anatomy of this region and the observation of these cases clinically we believe that Roux's explanation that bone infection is due to involvement of the lymphatics running from the skin through Sharpey's fibers to the periosteum, is untenable and that Kanavel's contention that it is caused by either the shutting off of the blood supply by the œdema incident to the infection or thrombosis of the digital vessels, rests on a sound anatomicopathological basis. There were 21 cases of osteomyelitis of the distal phalanx, an incidence of 33.8 per cent of the whole group, or 56.7 per cent of these cases where the infection involved the entire space. In 6 patients where a diagnosis was made on the roentgenological findings and the demonstration of "bare" bone by probing, conservatism resulted in early recovery. Bone sequestration did not take place. In 8 cases the tuft of the distal phalanx or a part of the diaphysis necrosed and was extruded or removed as a sequestrum. This occurred usually during the third or fourth week. Healing then took place rapidly. In 5 cases the diaphysis was completely involved and was removed by bone cutting forceps through an enlargement of the original incision. In four instances, one of them being

Fig. 17 (above). Case of phlegmonous lymphangitis due to streptococcus hæmolyticus with positive blood cultures. Entire superficial fascia of forearm, dorsum of hand, and arm sloughed. Extensive area of skin on back of hand became gangrenous necessitating later skin grafts. Case complicated by suppurative tenosynovitis of the ring finger tendon sheath and osteomyelitis of the fourth metacarpal bone. Photograph shows the extensive scarring and the deformity of the ring finger.

Fig 18. Same patient, anterior view. Note ability to extend completely the thumb, index, middle, and little fingers.

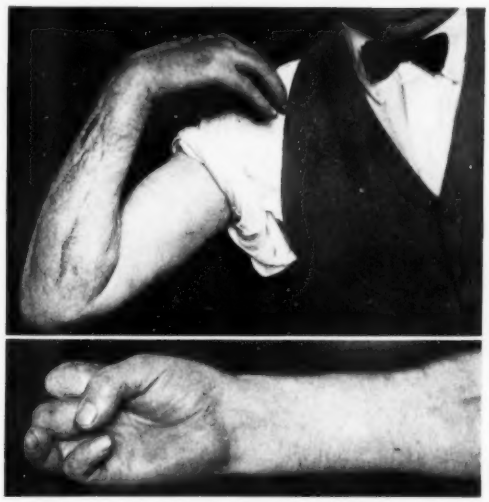

Fig. 19. Another view demonstrating full function in the elbow and wrist joints.

Fig. 20. Photographs of the hand of the same patient as in Figure 19 indicating full function in the interphalangeal joints, but considerable impairment in the metacarpophalangeal joints due to dense adhesions between the extensor tendons and the scar on the dorsum of the hand.

a child of 8 years, subsequent roentgenographic examination showed the growth of at least part of the diaphysis. In the fifth case there was no new bone formation at the end of 4 months. In the remaining two patients, of the total 21, there was serious involvement of the distal interphalangeal joint. Amputation was performed in both patients with removal of the cartilage at the end of the middle phalanx.

From the standpoint of end-results, therefore, there were 9 patients presenting permanent anatomical or functional disability. This is 14.5 per cent of the entire group. In two, fully 50 per cent of mobility was impaired in the distal interphalangeal joint. Both patients were over 50 years of age. Five cases presented shortening of the distal phalanx incident to surgical removal of the diaphysis. In four of these the nail was somewhat deformed. The permanent impairment in the remaining two was the result of amputation of the entire distal phalanx.

In 7 cases, some form of plastic operation was performed for deformed tender scars located usually at the end of the finger. Three patients presented an ingrowth of epithelium into the depths of the incision, a condition which was easily corrected. Depressed tender scars were excised and reconstructed in two other cases. Two patients, one a seamstress and the other a musician, presenting depressed scars with loss of a considerable part of the pulp, were subjected to the fat-graft operation described by Kanavel, with excellent anatomical and functional results.

LOCALIZED ABSCESSES IN THENAR AND HYPOTHENAR EMINENCES

Abscesses in the thenar and hypothenar eminences represent a relatively unimportant subdivision of hand infections. There were 14 cases, or 3.04 per cent of the total, 9 occurring in the thenar region and 5 in the hypothenar space. All were caused by direct inoculation, usually via a puncture wound. In hypothenar space infection, it was noted that mobility in the fingers was always free and active. Simple incision controls the infection. Two patients, with thenar eminence infections, presented physical signs suggestive of thenar space involvement. Determination of the anatomical

Fig. 21. Suppurative tenosynovitis of the flexor tendon sheath of the middle finger, complicated by a felon with necrosis of the tuft of the distal phalanx. The patient was operated upon approximately 24 hours after the onset of the symptoms. Culture of the small amount of blood-tinged fluid revealed staphylococcus hæmolyticus. A smear showed many leucocytes but few organisms. Photograph was taken on the sixth postoperative day and indicates the amount of active flexion at this early date. The eventual outcome was a return of complete function.

position of the puncture wound and the course of direction of the puncturing body, coupled with the absence of marked ballooning of the thenar space, were the chief points in differential diagnosis.

CHRONIC STAPHYLOCOCCUS INFECTIONS

Five cases of chronic staphylococcus infection came under our observation. Except for the local pathological lesion, all were relatively normal individuals, and their ages ranged from 26 to 42 years. In each instance some local cause for a continuation of the process was demonstrated and its removal brought about a speedy recovery. Two cases, with lesions on the dorsum of the hand, presented chronic indolent ulcerations with slightly raised inflamed edges. Numerous hair follicles were the centers of miliary abscesses. Attempts at epidermization were visible in scattered areas. One patient had been treating himself with bichloride wet dressings, and the other with carbolic ointment. In the latter case, small eschars were seen in the center of the ulceration. Cleansing and shaving of the surrounding skin, daily exposure beneath a Finsen lamp and daily dressings with a bland antiseptic ointment resulted in rapid recovery. The other three patients presented lesions on the fingers, one on the dorsal aspect and two over the anterior surface of an interphalangeal joint at the flexion crease. The cause for the chronicity in the first case was the constant immersion of the part in a solution of weak hydrochloric acid, a procedure necessitated by the patient's occupation. A vacation of 2 weeks resulted in rapid healing. In the last two patients, it was demonstrated that constant motion at the site of pathology kept up irritation and prevented healing. The application of a splint with bland dressings brought about prompt recovery. Three cases were examined bacteriologically and a pure culture of staphylococcus aureus was obtained in each instance.

SUPPURATIVE TENOSYNOVITIS

The subject of pyogenic infection of the flexor tendon sheaths is of very great importance from many standpoints. In order that even part of the function of the involved finger and hand may be retained, it is imperative that the diagnosis be made as early as possible and the proper treatment instituted immediately. After studying the 42 cases reported here and having the privilege of observing the course of about 20 others, we have become convinced that, if the diagnosis is made within 24 hours after the onset of symptoms and treatment instituted immediately, the function of a greater number of hands will be saved. We believe that Kanavel's remark, "in nearly every case an early diagnosis can be made and the function of the hand saved," is too sweepingly optimistic. It is agreed without argument that an early diagnosis can and should be made in nearly every case; but it appears that, in an appreciable proportion of the cases with optimum conditions present, such as early diagnosis, co-operation on the part of the patient and the institution of proper operative and postoperative treatment, some permanent defect in function of the involved part remains. In this analysis, the criterion for estimating end-results is the return of complete active mobility in the hand which is involved.

Of all the various types of hand infections, tenosynovitis is the most important and, at the same time, the most frequently badly

treated. It involves a part of the human anatomy the proper use of which is an economic necessity to the patient. We have seen a number of mutilated and functionally useless hands, the result of faulty diagnosis and multiple ill-advised and unnecessary incisions, in patients to whom the loss of function meant a cessation of their former means of livelihood.

One case, which was seen a few years ago, comes vividly to mind. This patient, 48 years of age, an accomplished pianist and teacher, developed an infection of one of his fingers following an insignificant pin-prick. He consulted a physician about 24 hours after the finger began to pain and swell. Under novocaine anæsthesia, numerous incisions apparently had been made on all aspects of the finger and dorsum of the hand in an attempt to locate the pus. Similar attempts were made on subsequent occasions until the tendon sheath was opened. When the case was seen about 2 weeks later, the flexor tendons were sloughing and there was an infection of the middle palmar space with an osteomyelitis of the middle phalanx. When this patient recovered, he was compelled to change his whole mode of life, which, to a man of his age, was little short of an economic tragedy. It is desired to emphasize the fact that suppurative tenosynovitis of the flexor tendon sheaths must not be considered a condition of minor importance and that its proper management constitutes one of the most difficult problems in surgery.

Forty-two cases are available here for study, 10.95 per cent of the entire series. Of these, 6 involved the thumb, 8 the index finger, 9 the middle finger, 7 the ring finger, and 12 the little finger. The size and position of the original injury appears to be of little importance as an aid in diagnosis or understanding of the pathogenesis. Thus, 16 patients remembered a simple pin-prick over the volar or dorsal aspect of some part of the finger. In 7 instances, there were small wounds of entry on the dorsum of either the middle or proximal phalanges. The remaining 19 cases presented lacerated or incised wounds of varying extent on the anterior aspect of the finger or adjacent palm. In 6 of the latter group, there was definite evidence of laceration of the tendon sheath with direct implantation. In 2 of these, the original wound had been sutured tightly as a first-aid treatment, a procedure which undoubtedly hastened the development of tenosynovitis.

When the symptoms and signs of tenosynovitis are sought for in an intelligent way, there should be little difficulty in diagnosticating this condition. It is always a question of differentiation from some other form of hand infection and the symptoms are found to be only a difference in degree from those found in simpler infections. Subjectively, the patient complains of severe throbbing pain in the entire finger and adjacent palm. He cannot localize it to any one place. On examination, one finds that the involved finger is held in a rigidly semi-flexed position. Active mobility, if at all possible, is extremely painful. The entire digit is uniformly swollen and, on closer examination, it is noted that the sides of the adjacent fingers are also swollen. The dorsum of the hand is œdematous and pits on pressure. The redness of the finger is not uniform, but presents a mottled appearance, its intensity being greatest on the sides and part of the dorsum of the finger and immediately adjacent hand. The whole hand is slightly tender to touch, but there is exquisite tenderness localized directly over the course of the sheath and most marked at its proximal end, overlying the metacarpophalangeal articulation. When an attempt is made to hyperextend the finger passively, great pain is produced which is again of greater intensity at the proximal end of the sheath. With regard to the swelling on the back of the hand, it is of great importance to realize its significance. In all of the more severe hand infections, the dorsum of the hand shows the greatest swelling, but it is rare to find pus here. In the cases coming under our observation, this finding was noted only four times. The failure to realize this fact is the cause for many ill-advised and unnecessary incisions.

From a pathological standpoint, two types of infection have been noted. In one, where the staphylococcus was the most frequently cultured organism, the infection was localized to the with hand, little, if any, systemic reaction. There appeared to be attempts at rapid localization and walling-off of the proc-

ess. In 3 cases adhesions had formed in the tendon sheath and the infection was definitely localized to its distal half. The other type is the acute fulminating variety where the streptococcus is the causative organism. The entire sheath rapidly becomes involved and the local manifestations are severe. There is usually a toxæmia of varying intensity. We have seen temperature elevations of 105 and 106 degrees F.

The proper management of these cases constitutes a most difficult and puzzling surgical problem. Where shall the incision be placed? Is it better to drain? If so, what form of drainage material should be used? How long should drainage be maintained? When can active and passive motion be instituted? What other therapeutic aids can be brought into play in order to bring about a good functional end-result? These are a few of the questions that arise when one is confronted with a case of suppurative tenosynovitis. A more extensive discussion of the treatment of this condition will form the basis of a subsequent paper. A few points are worthy of mention here. In the first place, it has been found distinctly advantageous to perform these operations in a bloodless field. An Esmarch bandage, properly applied, is most satisactory. It is removed either at the close of the operation or gradually loosened during the following hour. We have never seen any untoward complication which could be attributed to the use of the Esmarch. The question of anæsthesia is also very important. It is felt that a general anæsthetic, preferably of the gas-oxygen type, should always be administered. Any attempt to open infected tendon sheaths under local anæsthesia should be condemned. And in this connection, we have always insisted that these patients remain in bed until the infection has been completely controlled.

With respect to the proper placing of incisions, it has been found that the best method of approach is from the side of the finger. A study of the accompanying diagrams obviates any prolonged discussion. The side incisions avoid the most frequently used anterior surface of the finger, prevent the cutting of the flexion creases, produce relatively small, inconspicuous scars with minimum later contraction and, at the same time, can be made adequately to drain any co-existent lumbrical canal infection. The incision is always started at the side of either the proximal or middle phalanx and, depending on the extent of the pathology found and the virulency of the infection, is continued proximally until the end of the sheath is reached. In radial and ulnar bursal infections the result of extension from the flexor sheaths of the thumb and little fingers, the incisions can be extended to expose the palmar portions of these sacs. After using both the continuous and segmented incisions, we have come to feel that adequate drainage and, certainly, more rapid subsequent healing can very often be obtained when two separate incisions are used, one at the side of the finger and the other directly over the palmar prolongation of the sheath. However, it often becomes necessary to make both incisions continuous in order to secure more complete drainage.

As regards the use of drains, in general it can be said that the number of cases of sloughing tendons and tendon sheath adhesions is almost directly proportionate to the frequency and duration of their employment. The single outstanding factor in maintaining proper drainage after the first 24 hours is an adequate primary incision. Beyond that time, the use of a drain, however flexible and innocuous it may seem to be, is rarely ever indicated.

One of the most important phases of the postoperative treatment is the prevention of contamination and secondary infection of the wounds by other organisms. We feel quite sure that the chances for restoration of complete function are very greatly reduced as soon as secondary infection occurs. To prevent this, it becomes necessary to perform all postoperative dressings and treatments under strictly aseptic conditions. Especial reference is made to the use of sterile saline or boric acid solution, as the case may be, in sterile hand baths. As the entire hand and wrist are considered sterile, they are loosely wrapped in sterile towels between dressings. It is essential to continue these precautions until the wounds are nearly healed.

The early institution of active and passive motion and, later, light massage, hot wet

dressings, the daily exposure of the hand beneath some form of therapeutic lamp or any other device supplying concentrated dry heat, the daily painstaking dressings and the use at a later period of some form of mechanical device to promote finger mobility, are a few of the therapeutic aids within our reach which tend to help restore at least some function in these fingers. The important lesson we have learned from this type of case is that good results can be expected only when the minute details in the treatment are given as much prominence and attention as the apparently more important ones; and this attitude must be maintained throughout until treatment is terminated.

From the standpoint of the physiology, bacteriology, and pathology of this most interesting and extremely important subject, many queries arise. And we know that the answers to most of them have not as yet been obtained. For instance, whence does the tendon derive its blood supply? Granted a small wound of entry on the dorsum of the finger, how does the tendon sheath become involved? If by the lymphatics, as is so often and glibly stated, what is the anatomical course of the lymphatics and how do they end in the tendon sheath? What are the causative factors in necrosis of the tendon? What is the relation between the type of organism present and the subsequent recovery with and without tendon necrosis? What relation does the number of organisms and leucocytes in the tendon sheath fluid in early cases bear toward subsequent tendon recovery or death? An experimental study along these lines has been undertaken and we hope to report our findings. Of course such general questions as individual resistance of the patient to varying strains of organisms, the virulency of the infecting organisms, etc., are involved here as in infections elsewhere in the body.

As regards the extension of infection from the various tendon sheaths to the bursæ and fascial spaces, the following facts were determined. Of 12 cases of tenosynovitis of the little finger, in 8 the process had progressed and involved the ulnar bursa before the patients came for treatment. In six cases of tendon sheath infection of the thumb, the radial bursa was involved in four. Three of the 8 index finger infections had extended and involved the thenar space. In four of the six thumb tendon infections, the thenar space was the seat of abcess formation. The middle palmar space was involved twice in 9 cases of middle finger tenosynovitis, 3 times in seven ring finger infections and twice in 12 cases of little finger involvement.

Among the later complications, those of greatest importance were sloughing of the flexor tendons, osteomyelitis of the middle or proximal phalanx and suppurative arthritis in the proximal interphalangeal joint. Of the entire group of 42 cases, 30 or 71.4 per cent sloughed some part or the whole length of both the sublimis and the profundis tendons, rendering further active motion at the interphalangeal joints impossible. Table II shows the relationship between the time of onset of symptoms and institution of treatment and the subsequent fate of the tendons. It indicates in a graphic way the necessity of early diagnosis. In 8 cases, there was an osteomyelitis of varying severity and extent, involving the middle or proximal phalanx. The diagnosis was made by the clinical course, palpation of "bare" bone and X-ray examination. The proximal phalanx was involved in 6 instances, the middle phalanx in 2. In 7 cases there was an arthritis of the proximal interphalangeal joint.

When we come to analyze the end-results in the cases, some interesting facts are observed. Of the entire group of 42 cases, in 12, or 28.5 per cent, there was no evidence of tendon or tendon sheath necrosis. In 4 of these patients adhesions formed between the tendons and their sheath, thereby preventing full motion at the interphalangeal joints. Very little improvement followed after a prolonged course of properly administered physiotheraphy and mechanotherapy. Operative interference has not been attempted to date. In 6 cases, there was a return of complete function in the involved fingers. This amounts to 14.28 per cent of the whole group. The following digits were involved: One case of thumb tenosynovitis and radial bursa infection, two cases of little finger infection, one with and one without ulnar bursa involvement, one middle fin-

ger, one ring finger, and one index finger tenosynovitis. The remaining two patients attained complete function in the metacarpophalangeal and proximal interphalangeal joints, but because of an arthritis in the distal joint an ankylosis developed in this joint, thereby influencing the end-result. The remaining 34 cases present permanent anatomical, symptomatic, and economic impairment. As stated above, in 4 of these the tendons were intact but adherent to their sheaths. Further operative work might increase the range of active interphalangeal mobility. Nine patients were submitted to partial or total amputation, the important indications being extensive osteomyelitis of one or two phalanges with accompanying suppurative arthritis in the proximal interphalangeal joint and atrophy of the tissues of the whole digit with contracture of the scars. In each case of the latter group, amputation was performed at the patient's own request because the deformed finger interfered with occupational duties. In the remaining 21 patients, there is no active motion in the interphalangeal joints, but varying degrees of passive mobility indicating little or no pathology in the joints themselves. A normal range of active flexion is present in the metacarpophalangeal joints in 17 cases, a function made possible by the combined action of the lumbrical and interosseous muscles.

INFECTIONS OF THE ULNAR BURSA

There were 12 cases of suppurative ulnar bursitis, 8 of which were extensions of the infection from a tenosynovitis of the little finger. The remaining 4 were due to extension from a radial bursitis. The diagnosis of an involvement of this sac calls for a definite knowledge of the pathology present before the extension occurred and a proper evaluation of the various objective findings. Where a tenosynovitis of the little finger was previously present, extension to the ulnar bursa develops definite physical signs. The most important one is an extension of the tenderness to the area involved. In a few instances, tenderness was found to be most marked in that portion of the bursa located above the annular ligament. The entire hand increases in size, the œdema becoming more pronounced on the dorsum. Whereas before extension took place the other fingers were non-sensitive and freely movable, now they assume a semiflexed position, become sensitive to pressure and resist any attempt at passive hyperextension because of the pain produced. Another important finding is rigidity of the thumb and tenderness over the flexor tendon sheath and the radial bursa. This we think is due more often to the juxtaposition of the radial and ulnar sacs than to actual involvement of the radial bursa. There is also noted a fullness in the palm, confined to its ulnar half. The general concavity of the palm, however, remains intact. When the wrist region is examined more carefully, it is found that the hand is held in a position of moderate flexion and slight ulnar deviation. The whole region is swollen and of a violaceous hue. The swelling appears more marked above the annular ligament because of the latter's lack of distensibility. The flexion creases over the anterior aspect of the wrist are now more conspicuous and the skin folds stand out more prominently. A rise in temperature of from 2 to 4 degrees was seen in 9 of the 12 cases.

When the question of extension of the infection from the ulnar bursa was analyzed, it was found that the middle palmar space was involved in three instances and the proximal end of the bursa had ruptured in 5 cases, with secondary deep forearm abscess formation. In 4 cases, one-third of the total number, the radial bursa became involved. These figures agree approximately with Forssell's who found 6 in 29 cases. It has been our experience, although the number of cases is small, that Kanavel's 75 to 85 per cent of secondary involvement of the radial bursa from a primary ulnar bursitis is somewhat high. The diagnostic points of extension to these fascial spaces and synovial sacs will be taken up under their respective headings.

The treatment here, as in tenosynovitis, calls for properly placed adequate incisions. Figure 2 shows the anatomical positions of the various incisions in the hand and above the wrist. It is our desire to emphasize the fact that the prolongation of the bursa above the wrist cannot be drained by an incision over the front of the wrist, because it then becomes

necessary to separate the various tendons and introduce drainage material to keep the wound open, a procedure which helps materially in bringing about tendon necrosis. Figure 15 represents such a case in which an attempt had been made to drain the deep spaces of the forearm by such incisions. This patient was first seen after a number of the flexor tendons at the wrist had sloughed. Needless to say this hand is totally useless. Properly placed, long ulnar side incisions will drain very satisfactorily the deeply situated bursa. The dictum "a large incision with free drainage will heal more rapidly than a small incision with inadequate drainage" is particularly applicable here. After the first 24 hours, all drainage material is dispensed with. Its use is very rarely indicated after that period. On two occasions it was found necessary to split the anterior annular ligament, in order to properly drain virulent infections involving both the ulnar and radial bursæ. With the hand splinted for a few days in hyperextension, prolapse of the tendons did not occur and no untoward later effects were noted which could be attributed to the cutting of this structure *per se*.

It is difficult to properly evaluate the end-results in this type of infection because of the concomitant involvement of one or more of the tendon sheaths; that is, those of the little finger and thumb. However, it appears that the function in the wrist joint and the other fingers must be determined, because of the proximity of the former and the tendon sheath of the latter to the ulnar bursa. In 8 of the 12 cases the wrist joint has remained practically unimpaired. An impairment ranging from 20 to 50 per cent, especially as regards extension, was noted as an anatomically defective end-result in the remaining four. In 7 patients, there has remained some permanent decrease in the range of active flexion of the index, middle, and ring fingers, varying from 10 to 30 per cent. This is presumably due to the presence of scar tissue about the proximal ends of their vaginal sheaths.

RADIAL BURSA INFECTIONS

Of the 10 cases of radial bursa infection, 4 were due to extension from a tenosynovitis of the thumb, 4 were caused by a preexisting ulnar bursitis and 2 were the result of traumatic amputations of the thumb with secondary infection. As in ulnar bursitis, the symptoms and signs are here also quite distinctive. When extension occurs from a thumb tenosynovitis, the patient notices an increase in the area of pain, including the thenar eminence and the wrist. On examination one finds that the thumb is held rigidly in semiflexion and the entire thenar eminence is swollen, the latter lacking, however, the great ballooning out so characteristic of thenar space infection. The redness is mottled in appearance and distributed over the entire thumb, thenar eminence, and anterior aspect of the wrist where it assumes a violaceous tinge. The œdema on the dorsum of the hand becomes more pronounced. The entire thenar eminence is tender. As in ulnar bursitis, tenderness was found to be most marked in two or three instances at the proximal end of the sac above the wrist. It is further noted that the hand is held in moderate flexion and radial deviation. An important negative finding is the absence of pain and the relative freedom of motion in the other fingers, especially the ring and little fingers. The sudden development of some pain in these fingers and the assumption of a position of rigid semiflexion resisting extension, coupled with a progression of the area of tenderness both in the hand and above the wrist means one thing only, a secondary involvement of the ulnar bursa. In these 10 cases, this complication occurred 4 times, a percentage somewhat lower than that mentioned by Kanavel and Forssell. Other paths of extension included 4 cases of thenar space infection and 4 of rupture of the proximal end of the sac with secondary deep forearm abscesses beneath the flexor profundis tendons.

From the standpoint of treatment, the incisions must be radical, properly placed, and carefully made. In the hand, the incision starts over the proximal phalanx of the thumb more toward its ulnar side, and continues around into the thenar eminence, running somewhat parallel to the adduction crease. The two heads of the flexor brevis pollicis muscle are separated and ready access is gained to the bursa. The muscular structures making the thenar eminence should not be

ruthlessly divided, because the important apposing function of the thumb depends upon their preservation. The precaution of avoiding injury to the nerve supplying these muscles by ending the incision at a point 1 inch distal to the anterior annular ligament makes also for better later function. When the findings indicate an extension above the wrist, the external lateral incision secures adequate drainage. Here particular care must be taken to avoid injury to the radial artery. The anatomical position of this incision is not without danger. One of these 10 cases, on the third postoperative day, had a severe secondary hæmorrhage from necrosis of the wall of the radial artery. The timely and intelligent interference of the nurse prevented a rapid exitus. The artery was later exposed and ligated successfully. To drain a radial bursa infection alone, even with extension above the wrist, we do not think it is ever necessary to split the annular ligament. If the involved tendons are grossly necrotic or have been the seat of infection for some time, they should be excised because the period of suppuration is greatly decreased and the other important structures beneath the annular ligament are less liable to further damage.

As in ulnar bursitis, the end-results in this condition are intimately connected with the final outcome in the frequently associated tenosynovitis of the thumb or little finger. Mobility in the wrist joint remained practically unimpaired in all the cases. In 4 of the 10 patients, 40 per cent, there was a noticeable impairment in the apposing action of the thumb. Except when the ulnar bursa became secondarily involved, mobility in the fingers remained normal. The question of tendon necrosis both in ulnar and radial bursitis was discussed in the section on tenosynovitis.

THENAR SPACE INFECTION

Definite thenar space infection was encountered 17 times, 3.7 per cent of the entire series. Of these, 3 were caused by extension from a suppurative tenosynovitis of the index finger, 4 were secondary to tenosynovitis of the thumb, 4 were due presumably to extension from a radial bursitis, and 6 were definitely caused by direct inoculation. In the latter group, there were 4 cases with deep puncture wounds on the dorsum of the first web region and 2 with compound fractures of the metacarpal bone of the index finger. The thenar space abscesses in the last 2 cases were secondary complications, diagnosed respectively 6 and 11 days after the original injury. In this connection it might be stated that we have never seen an infection of the thenar space which could be traced definitely to a preexisting middle palmar space abscess. On the other hand, we have seen 3 cases where the spaces were simultaneously involved, but presumably from different sources.

The signs and symptoms of this very definite clinical entity might be reviewed quite satisfactorily by a description of the findings in a recent case:

Case 1. Mr. C. L., age 31, 5 days ago, while working at a buzz-saw, sustained an injury to the right hand when a narrow piece of wood was fired back and pierced it. The wound of entry was located on the dorsum of the hand over the first interosseous space, the direction of the foreign body apparently being forward and inward toward the center of the palm. The splinter of wood was removed as a first-aid treatment and a dressing applied. During the succeeding 3 days the patient experienced severe throbbing pain in the hand, most marked in the region of the thenar eminence. This was accompanied by a progressive increase in size of the hand. On examination the following was noted: Although the entire hand was swollen, the thenar eminence stood out markedly, giving the appearance of capacity distention. The entire thumb seemed to stand away from the rest of the hand, with the terminal phalanx held in a position of acute flexion. The œdema on the dorsum of the hand was quite pronounced. Active and passive motion in all the fingers was free, although some restriction was noted in the thumb and index finger. The latter was not the rigidity noted in tenosynovitis. The entire thenar eminence, the adjacent web space and back of the hand, and the thumb displayed a uniformly light red, slightly cyanotic color. Tenderness was most marked over the prominent thenar eminence and along the web between the thumb and index finger. A most noticeable objective finding was the definite induration of the whole thenar area. This is a most important point in differentiating thenar space abscess from the œdema present when the middle palmar space is involved. On admission to the hospital the temperature was 103.4 degrees F. Under gas-oxygen anæsthesia, the space was drained and about 1½ ounces of pus liberated. A small rubber dam drain was inserted down to the bottom of the space. With hot saline wet dressings for twenty-four hours, rest in bed, and catharsis, the swelling promptly sub-

sided and drainage decreased. The operative wound was healed in 2 weeks and there was a restoration of complete function.

The most important step in the treatment, once the position of the pus is definitely determined, is the proper placing of the incision. It has been found that the space can be drained most satisfactorily, at the same time avoiding injury to the intrinsic muscles of the thumb, by making the incision over the first dorsal interosseous space, running it parallel to and at about the center of, the metacarpal bone of the index finger. An artery clamp is then inserted anterior to the index metacarpal and the entire space opened widely. It is to be remembered that the limit of the thenar space in the palm is the origin of the adductor transversus muscle from the anterior surface of the shaft of the middle finger metacarpal. Care must be taken not to push the artery clamp through the muscle into the mid-palmar space. The pus may be either in front of the adductor transversus pollicis muscle or upon both its dorsal and ventral aspects. Subsequent drainage is maintained by the use of rubber dam or rubber tissue strips or vaselinized gauze, the drain being carried down to the bottom of the space. The duration of drainage will depend on the course of each individual case. In the majority of cases it is seldom necessary after the third day.

Only 4 instances of extension of the infection from the thenar space were seen. These took place along the lumbrical canal of the index finger and the tissues about its flexor sheath or the web region between the thumb and index finger became involved. We have never seen a case of extension from the thenar space to the mid-palmar space. On the other hand, secondary involvement of the thenar space from a primary mid-palmar space infection would seem to be more easy of development, although we have never seen such an instance.

Even in relatively late cases there is no reason why complete restoration of function should not follow if the incision is properly placed and the postoperative care is carefully followed out. Of course, in a number of cases the end-result is dependent upon the outcome of the infection in adjacent structures. Thus, in this series the preexisting infection of the index finger flexor tendon in 3 cases and the thumb tendon in 4 cases, decided the permanent impairment in the hand, if any remained. After a careful analysis and study of the cases here recorded, one could not plausibly determine any permanent anatomical (including scar contraction) or symptomatic disability which could be attributed to the thenar space infection *per se*.

INFECTIONS OF THE MIDDLE PALMAR SPACE

Next to suppurative tenosynovitis, infections of the middle palmar space are most frequently overlooked or incorrectly diagnosed. There are many reasons for this. In the first place, the space is so deeply situated that, coupled with the superimposed relatively nonresistant palmar fascia, the physical signs are not as distinctive as in infections of the tendon sheaths or the thenar space. Then again, the signs and symptoms of the preexisting or simultaneous infection of one of the tendon sheaths or the presence of some crushing injury to the hand may overshadow the mid-palmar infection. And lastly, it appears that the exact anatomical position and extent of this space is not known and recognized as universally as it should be. As demonstrated by Kanavel's experimental injection studies, this space is situated in the palm of the hand dorsal to the flexor tendons, that is, behind them, and has the general appearance and shape of an inverted truncated cone, the broad base being directed distally toward the fingers, the smaller end toward the wrist. Externally, it is limited by the origin of the adductor transversus pollicis muscle from the anterior surface of the middle finger metacarpal, this muscle serving as a partition between the thenar and palmar spaces. Internally, it is overlaid by the distal half of the ulnar bursa and extends as far as the outer side of the little finger metacarpal. Its distal extremity may be represented externally by the inner extremity of the distal palmar crease and its proximal end is located in the region of the bases of the third and fourth metacarpals.

Whether the infection is due to extension from a tenosynovitis or to direct implanta-

tion following an injury, the physical signs are the same. If sought for carefully and intelligently, bearing in mind the previous history of the case, diagnosis ought not to be difficult. The patient's complaints are severe, throbbing pain most marked in the palm, and a rapid increase in size of the hand. Objectively, one finds that the dorsum is markedly œdematous. The palm, the web spaces between the middle, ring, and little fingers and the adjacent dorsum present a livid appearance. The outstanding single objective finding is the loss of the concavity of the palm which now appears to bulge. This is best seen by viewing the hand from the side. Because of the anatomical proximity of the tendon sheaths of the middle, ring, and little fingers to the space, these digits assume a rigid semiflexed position. However, this rigidity is relative inasmuch as the fingers can be extended and flexed rather freely, thereby differentiating this infection from tenosynovitis. The thenar eminence, because of the laxity of its tissues, is swollen. But this swelling is of the soft œdematous variety as differentiated from the firm induration seen in thenar space infection. Palpation reveals induration in the palm and tenderness, most marked over the anatomical position of the space. Fluctuation can seldom be obtained because of the deep position of the pus.

As in thenar space infection, the most important phase of the treatment is a properly placed adequate primary incision. We have used the incision recommended by Kanavel in every case with entire satisfaction. Figure 3 represents the outline of the space and the incisions used. It can be extended distally to drain any involvement of the lumbrical canal. If the inner lumbrical space is infected, it would seem best to incise between the fourth and fifth metacarpals and drain both spaces through the same incision. The flexor tendon sheaths are pushed aside and an artery clamp is inserted beneath them into the space. When the blades are separated, satisfactory drainage ensues. A strip of rubber tissue or rubber dam is then inserted. The postoperative treatment is the same as in thenar space infection. We have been impressed with the rapidity of recovery in these cases, once the proper incision was made. Just as soon as it is evident that the infection has abated, light massage should be instituted. This tends to prevent adhesions about the superimposed flexor tendon sheaths.

Fifteen cases of this type of infection were observed. Three were definitely the result of extension from an ulnar bursitis, 2 were caused by a pre-existing little finger tenosynovitis, 2 from a middle finger, and 3 from a ring finger tendon sheath infection. Of the remaining 5, 3 gave histories indicating either deep puncture wounds or deep lacerations and 2 had crushing injuries of the hand with compound fractures of the metacarpal bones of the ring and little fingers, respectively. In one of the latter cases there was also an infection of the subaponeurotic space on the dorsum of the hand and through and through drainage between the third and fourth metacarpals was employed. In the majority of cases, one or both associated lumbrical canals were also involved. With regard to other paths of extension, we have never seen instances of secondary thenar space, ulnar bursa, or deep forearm involvement. Barring the case of crushing injury with compound fracture of one of the metacarpals, burrowing of the pus between the metacarpals to the dorsum of the hand was never observed.

End-results, as in thenar space infections, are in the majority of cases intimately associated with the final outcome of the accompanying tenosynovitis or bursitis. However, in uncomplicated cases of middle palmar space infection, there is no reason why there should not be a return of complete function in the great majority. In our 5 uncomplicated cases, complete restoration of function was obtained in 4, or 80 per cent. In the fifth, where a compound fracture and osteomyelitis of the fourth metacarpal preceded the development of the mid-palmar abscess, there remained about 50 per cent impairment of full flexion at the metacarpophalangeal and interphalangeal joints of the right ring finger. This is due possibly to adhesions about the flexor tendon sheaths or to secondary changes in the joints themselves.

DEEP FOREARM INFECTIONS

Kanavel's studies demonstrate in a most conclusive manner that accumulations of pus in the forearm follow definite anatomical

fascial planes and that nearly every case of deep forearm abscess can be traced to some antedating infection of the hand, usually a radial or ulnar bursitis. Our experience with 9 cases would tend to bear out his findings and contentions. Thus, of these 9 cases, 5 were due to extension from an ulnar bursitis and 4 were caused by rupture of a previously infected radial bursa. In this connection it might be stated that we have never seen a case of forearm infection secondary to a thenar or middle palmar space infection. In 6 patients the upper limit of extension was approximately the middle of the forearm. In the remaining 3 practically the entire anterior compartment of the forearm was involved.

When an ulnar or radial bursitis ruptures and the forearm becomes involved, the pus comes to lie behind the flexor profundis digitorum tendons and upon the pronator quadratus muscle. It occupies a fairly large-sized space approximately 2 or 3 inches above the wrist joint. With extension of the infection, the pus is found lying on the interosseous membrane. About 4 or 5 inches up on the forearm, the pus tends to leave its deep position and follow intermuscular septa, most commonly that one between the flexor carpi ulnaris and the flexor sublimis digitorum muscles. It then passes into the sheaths surrounding the ulnar artery and nerve on the one hand and the median nerve on the other. Its further course is along the vessels and nerves. It may extend toward the elbow, following most often the course of the median nerve. In the majority of cases, however, it seems the pus proceeds distally along the ulnar vessels and nerve and comes to lie subcutaneously just above the wlist. The great probability of a deep colrection of pus must be borne in mind when confronted with such a subcutaneous infection over the front of the wrist sequential to a radial or ulnar bursitis. These subcutaneous collections are found only in relatively late cases.

With the knowledge of the history concerning the beginning of the infection in the hand and the physical signs, diagnosis should not be difficult. The entire forearm increases in size. The swelling present is not particularly indurated but, on palpation, gives the sensation of tenseness, as if the forearm were overdistended. It does not pit on pressure. The wrist becomes fixed in a position of semiflexion. Any attempt at extension causes considerable pain. The skin is slightly cyanotic, more marked at the wrist and gradually shading off in the direction of the elbow. Deep pressure over the anterior part of the forearm elicits pain. As the infection progresses, the skin becomes reddened and induration is then noted. In early cases fluctuation can never be obtained because of the deep position of the pus. Later, fluctuation is demonstrable when the subcutaneous tissues above the wrist become involved. Other important clinical findings are elevation of the temperature and a rise in the total and polymorphonuclear leucocyte count.

Both from the mechanical and anatomical aspects, it appears evident that adequate and continued drainage cannot be obtained by incisions made over the front of the wrist. Inasmuch as the pus is deeply situated and overlaid by the various flexor muscles and tendons, anterior incisions must of necessity be long, must involve cutting and separation of muscle bellies and tendons and require the use of semirigid drainage material in order to maintain drainage. This favors necrosis of fascia and tendons and prolongs convalescence. Figure 15 represents a case treated in this way.

In the other 8 cases, the use of the side incisions gave equally good drainage and rapid recovery (Fig. 4). When the infection has extended upward toward the middle of the forearm, the incision is made on the ulnar side also, but about an inch toward the anterior surface. This is done in order to reach the intermuscular septum between the flexor carpi ulnaris and the flexor sublimis digitorum muscles. Drainage material, usually rubber dam or vaselinized gauze is seldom needed after 36 hours.

With the exception of the one case represented by Figure 15, the end-results were universally good. In 4 cases we observed that there was a noticeable loss in muscle strength, that is, grasping power of the hand. This condition eventually cleared up in greater part. Not one case of wrist joint involvement

was encountered in this series. Secondary hæmorrhage was never observed, aside from that case described in the chapter on radial bursitis, of necrosis of the radial artery.

SUPPURATIVE TENOSYNOVITIS OF COMMON EXTENSOR TENDON SHEATH

A pyogenic infection of the common extensor tendon sheath seems to be an uncommon condition. Kanavel reports having seen 4 cases. Two were encountered in this series. Their histories bring out a number of interesting points.

CASE 2. Mrs. L. M., age 37, five days ago, while opening a can of food, cut the dorsum of her left hand on the edge of the can. A fairly deep wound was produced, but the extensor tendons were not injured. Two days later, the patient began to experience marked pain about the wound, accompanied by rapid swelling and restriction in flexion of the fingers and wrist joint. Examination showed a transverse irregular lacerated wound, about 2.5 centimeters in length, on the dorsum of the left hand, 2.5 centimeters distal to the wrist joint. The entire dorsum of the hand, wrist, and lower forearm was swollen and red. There was exquisite tenderness over the dorsum of the wrist, carpus, and adjacent hand. Pus oozed from the wound when pressure was applied in these regions. The fingers were held in the extended position and the wrist joint was slightly dorsiflexed. Attempted active or passive motion in the fingers caused pain. The temperature was 101.4 degrees F. Under general anæsthesia, a longitudinal incision was made on the dorsum, extending from about the center of the middle metacarpal bone backward as far as the wrist joint. The posterior annular ligament was split. Pus was found in the tendon sheath. Two small rubber dam drains were placed in the lateral parts of the sheath and the hand and wrist were immobilized on an anterior splint. Following this procedure, the temperature dropped to normal and the subjective symptoms abated. The drains were removed at the end of 48 hours and the palmar splint was dispensed with on the fourth day. When the infection had subsided, active motion and light massage were instituted. The operative wound was healed in 2 weeks. Convalescence proceeded rapidly and the patient now, 9 months later, has a normally functionating hand.

CASE 3. T. S., man, age 46, about one week before, ran a nail into the back of his hand. The wound was iodinized and he paid no more attention to it. About 3 days later, he began to experience considerable difficulty in active motion of the fingers. This he attributed to the already present swelling on the dorsum of the hand. Aside from a dull ache in the region of the wrist, the patient experienced no pain and had been able to sleep each night. Examination of the right hand showed considerable swelling on the dorsum of the hand and wrist. The skin was slightly cyanosed. Palpation revealed some tenderness over the dorsum of the carpus on very firm pressure. The tissues felt indurated. The fingers were extended but could be flexed somewhat. Mobility at the wrist was fairly free. The temperature was 99 degrees F. As the true extent of the pathology was not surmised, conservative treatment was instituted. Instead of subsiding, the swelling increased and greater pain was experienced. Because of the increasing induration, it was felt that an incision was in order. The ante-operative diagnosis was abscess of the dorsal subcutaneous space. A longitudinal incision over about the center of the hand showed nothing but œdematous subcutaneous tissues. Extending the incision toward the wrist, the extensor sheath was exposed and nicked. A small quantity of pus escaped. The entire sheath was then split from its proximal to its distal end and the annular ligament was also divided. This patient went on to a rapid recovery, without sloughing of any of the tendons and with a restoration of complete function.

In considering the surgical aspects of pyogenic infections of the dorsal tendon sheath, the following facts may be noted:

1. Anatomically, the sheath embraces the tendons of the extensor communis digitorum and the extensor indicis muscles. It is located rather far back on the hand, extending from about the upper edge of the posterior annular ligament distally for a distance of 5 to 6 centimeters.

2. The physical signs are not nearly as distinctive as those of flexor tenosynovitis.

3. If the sheath should rupture, the pus would tend to diffuse in either the dorsal subcutaneous or subaponeurotic spaces, probably more often in the former. The absence of definite fascial planes and spaces on the dorsum of the wrist and forearm into which the infection could extend greatly simplifies conditions, in this respect differing markedly from infections on the anterior aspect.

4. Simple longitudinal splitting of the sheath seems to control the infection.

5. It is rather uncommon to see sloughing of any of the extensor tendons. This brings up the as yet unanswered query, "What is the difference between the flexor and extensor sheath infections and what are the factors involved which make for the usually rapid and complete recovery in extensor sheath infections, as opposed to the prolonged course and

relatively infrequent complete return of function in the flexor sheath infections?"

SECONDARY OSTEOMYELITIS

Of the 29 cases of secondary osteomyelitis, 21 had an osteomyelitis of the distal phalanx. They were analyzed in the section on "felons." The remaining 8 cases form an altogether different group, clinically and pathologically. All were secondary complications of a preexisting tenosynovitis. Any patient presenting a chronic discharging sinus over the middle or proximal phalanx following suppurative tenosynovitis of the flexor tendon sheath, may be sure to have either a sloughing tendon, an osteomyelitis of one or both phalanges or a suppurative arthritis in the proximal inter-phalangeal joint. Frequently, all three are present together. More often, a sloughing tendon and an osteomyelitis are combined. In 4 of these cases there was extensive destruction of both the proximal and middle phalanges, as well as the proximal interphalangeal joint, and amputation was performed in each instance. In the remaining 4 patients, the middle phalanx displayed infections varying from a cortical osteomyelitis of the shaft to destruction of the entire proximal end. Three cases had an arthritis in the proximal joint. The first patient promptly recovered after extruding a small sequestrum from the anterior surface of the middle phalanx. In the remaining 3, it was found necessary to remove the proximal end of the middle phalanx. At operation it was noted what remarkably little change had occurred in the head of the proximal phalanx, even in the face of an arthritis of the proximal joint. The after-treatment in these cases consisted of traction and extension on a palmar splint. The wounds healed after 3 to 4 weeks, with complete ankylosis of the proximal interphalangeal joint.

The end-results, then, may thus be summarized: Of 8 cases, 4 came to amputation because of extensive disease. One recovered without loss of any appreciable part of the phalanx and without actual impairment of the joints. The remaining 3 showed an anatomical loss of the proximal one-third of the middle phalanx with an ankylosis of the proximal interphalangeal joint. In addition to this, some shortening of the finger was evident in each case.

The diagnostic features of phalangeal osteomyelitis may thus be enumerated:

1. The sequence of events in the history of the case.
2. The clinical course while the patient is under observation.
3. The presence of sinuses, consisting of volcano-like appearing flabby granulation tissue with a central crater leading down to the site of pathology.
4. The exclusion of other causes of chronic sinuses, such as sloughing tendons, foreign material (drains), etc.
5. The determination of "bare" bone by probing.
6. Roentgenographic examination.

In the treatment of these cases, it appears that a certain proportion will go on to a satisfactory outcome with conservatism. This is true especially of diaphyseal osteomyelitis and uncomplicated suppurative arthritis. If there is gross destruction of the phalanges and the proximal joint, for the majority of patients, the best treatment is amputation. Sometimes, whether for cosmetic or other reasons, the involved phalanges may be resected and a fair result obtained. When the thumb is the involved digit, we feel that everything possible should be done before amputation is resorted to, because the apposing action of the thumb, be it only a part of its former self, is one of the most important actions in the hand.

INFECTIONS OF THE PALMAR FASCIA

Infection of the palmar fascia, apparently of some rarity, was seen on two occasions. It is characterized by an infection of the palmar fascia, involving both its superficial and deep surfaces and results ultimately in sloughing of a part or the whole of this fascial layer. In one case observed, the entire fascia with its digitations going to the fingers was found at operation to be completely separated from its superficial and deep attachments and was removed practically *en bloc*. The other patient showed necrosis of only a part of the proximal and of the palmar fascia. The histories, in detail, are as follows:

CASE 4. E. Camp, age 62, one week before admission, injured his right hand when a piece of wood pierced the palm near the wrist. The splinter was removed but the hand began to pain and swell. No treatment of any sort was received during the first week. Examination showed an infected puncture wound discharging pus in the palm just distal to the wrist. The entire palm was swollen and its normal concavity was replaced by a convexity. The skin of the palm was shiny and red. Swelling on the dorsum of the hand was enormous. Palpation revealed greatest tenderness in the palm at its base and gave the sensation of a palm filled with fluid. Finger mobility in the index and middle fingers was fairly free. The ring and little fingers were deformed as a result of a former injury. The temperature was 102 degrees F. The apparent superficial location of the pus and the anatomical position of the original puncture wound were the main points in differentiating this condition from an infection of the midpalmar space. Operation showed that the palmar fascia was completely separated from the subcutaneous tissues on its superficial surface and from the intrinsic hand muscles on its deep aspect. In each space thus formed was a small lake of pus. The fascia, grossly necrotic, lay between them. Numerous incisions were made and the fascia was excised. In 4 weeks all wounds were healed and full function had returned (Fig. 16). It is interesting to note that the ability to produce a hollow in the palm of the hand is only partially lost. Anatomists contend that the palmaris longus muscle through its palmar fascial expansion is the main factor in this action.

CASE 5. A boy, age 19, gave a history almost identical to that in Case 4. Five days before, the patient sustained a puncture wound in the right palm at its base. This was followed by an infection for which a small incision had been made elsewhere. Improvement did not follow this procedure. Examination showed a small incision in the right palm at the proximal end of the adduction crease. The surrounding palm was swollen, red, and tender. The general palmar concavity, however, was intact. Finger mobility was good and swelling on the dorsum of the hand was not excessive. The temperature was 100.8 degrees F. Operation revealed the presence of a small abscess consisting of two pockets, the proximal end of the palmar fascia forming the septum between them. About one-half ounce of pus was evacuated and the grossly necrotic fascia excised. When the patient left the hospital 3 days later the swelling had subsided but the wound was still draining. He did not return for further treatment. In this case there was considerable tenderness along the course of the ulnar bursa, which, with the general fullness of the palm, rendered diagnosis somewhat difficult.

Cultures of the pus in both cases showed the presence of staphylococcus aureus. Interest in this condition attaches mainly to the differential diagnosis from the bursal and fascial space infections, to the peculiar pathology found at operation and the rarity of the disease. Simple incision over the point of greatest tenderness with excision of the necrosed fascia seems to form the basis of treatment.

PHLEGMONOUS LYMPHANGITIS

It did not appear advisable or necessary to analyze all the cases of lymphangitis and discuss them under a separate heading, for the reason that a large number of the local hand infections were accompanied by some degree of lymphangitis of the hand and forearm and lymphadenitis of either the epitrochlear or axillary glands. The cases of local lymphangitis, confined to the hand mainly, have been discussed under the heading of simple abscesses. It is our purpose in this section to speak of another form of lymphangitis, one characterized by severe local, and often general, manifestations in which there is an appreciable mortality rate.

The point of origin is usually an insignificant wound on some part of the fingers or hand. With this as a focus, the infection spreads rapidly and appears to be confined to the lymphatics of the skin and subcutaneous tissues on the dorsum of the hand and forearm. Instead of the soft pink pitting œdema which accompanies the simple lymphangitis, the great swelling which follows the onset of this infection is indurated and bluish in color. The skin soon becomes covered with small vesicles and presents an appearance suggestive of erysipelas. The patient complains of severe throbbing pain in the involved parts and presents clinical evidence of an intoxication of varying severity, with high temperature, chills, prostration, anorexia, etc. Locally, one finds none of the symptoms and signs of tendon sheath or fascial space infection. Whether the symptoms of the lymphangitis overshadow possible infections in these regions or secondary infection occurs at a later period, it has been noted that these spaces do show evidences of infection in a number of cases, at some later stage of the disease. The characteristic finding is the bluish, firm, indurated swelling of the superficial tissues on the dorsum of the hand and forearm, sometimes extending to the shoulder. In the pres-

ence of such an infection, incision is indicated, for it is found that the skin is completely undermined by pus and the subcutaneous tissues and superficial fascia are grossly necrotic and can be removed in large pieces. In some cases the entire superficial fascia of the forearm and back of the hand becomes necrotic. In the presence of this necrosis, the vitality of the overlying skin becomes impaired and soon isolated areas of skin gangrene are visible and they coalesce or individually increase in size until, sometimes, extensive parts of the hand and forearm become denuded of skin, necessitating either prolonged convalescence or secondary skin grafting. In some cases the infection may be so severe as to overwhelm the patient. In this group occurred the only death of the entire series. From the bacteriological standpoint, it appears that the streptococcus family of organisms is the most common with the staphylococcus aureus the next most frequent.

Four cases of this type of infection were encountered. All were male patients, ranging in age from 36 to 65 years. Two of them had relatively low-grade staphylococcus aureus infections which involved the dorsum of the hand, wrist, and distal two-thirds of the forearm. Although there were large quantities of pus beneath the skin, necrosis of the fascia and subcutaneous tissues was not advanced. In one patient an area of skin on the back of the hand measuring about 3 centimeters in diameter became gangrenous. Skin grafting was not done. In this case there remains a permanent decrease of mobility at the metacarpophalangeal joints of all the fingers, amounting to 50 per cent, a fair anatomic end-result. The other patient recovered with a restoration of complete function.

The third case was an old Italian, 65 years of age, in poor physical condition. He presented an extensive involvement of the hand and forearm which rapidly extended to the arm and shoulder. The streptococcus hæmolyticus was isolated in pure culture. As the infection progressed, new incisions were made, but it seemed that neither the patient nor surgery could control its advance. The septic course continued, in spite of adequate drainage and repeated transfusions. As the patient rapidly grew weaker, the infection spread along the right side of the chest wall. He died suddenly, 4 weeks after admission to the hospital, following a severe hæmorrhage due to erosion of one of the vessels in the back muscles.

As the fourth case presents many interesting points, it will be reviewed in some detail.

CASE 6. O. L., age 36, a mechanic, ten days ago, while at work at a machine, accidentally cut the dorsum of his right index finger in the region of the proximal interphalangeal joint. He continued working the succeeding two days without a protective dressing over the wound. He then began to experience pain in the finger, soon extending to the dorsum of the hand. On the following day, the patient consulted a physician who diagnosed the condition as erysipelas and treated it as such for a week. No improvement followed. The writer saw the patient on the tenth day of his illness. Examination showed an acutely ill, prostrated, male adult apparently in severe pain. The entire right hand, forearm, and arm was fully two and one half times its normal size. The skin was livid in appearance, most noticeable on the posterior aspect. The dorsum of the hand, forearm and distal half of the arm was covered with vesicles of various dimensions, containing clear yellow fluid. Because of the greatly thickened skin, each hair follicle stood out prominently, resembling the *peau d'orange* appearance seen frequently in carcinoma of the breast. The entire hand was sensitive to touch, but there was no one point of maximum tenderness and active mobility in the fingers was fair. Further examination showed a practically healed incised wound on the dorsum of the index finger. The entire back of the hand and forearm was considerably tender and the induration present felt brawny. No fluctuation was demonstrable. Mobility at the elbow and shoulder joints was as free as the swelling would permit. The temperature was 105.6 degrees F. White blood corpuscles, 28,000; polymorphonuclear leucocytes, 88 per cent. A blood culture taken at this time was reported positive for streptococcus hæmolyticus with a scant growth. The patient was anæsthetized and an incision was made on the dorsum of the hand. A large quantity of pus was found in the dorsal subcutaneous space. The dorsal tendon sheath appeared to be uninvolved. With this incision as a starting point, numerous succeeding ones were made on all aspects of the forearm and outer side of the arm for drainage and counterdrainage. Great quantities of pus were evacuated. Large necrotic masses of fascia and subcutaneous tissues were found lying free in this sea of pus. It was apparent that the entire forearm was completely encircled by pus which cultured streptococcus hæmolyticus. The upper limit of the infection appeared to be at about the mid-humeral region.

The postoperative course of the patient was stormy. On two occasions it was found necessary to

make counter incisions on the posterior surface of the arm. A collection of pus was found between the brachialis anticus and biceps muscles. Practically the entire superficial fascia of the forearm and arm sloughed out in large necrotic pieces. The major portion of the skin on the back of the hand became gangrenous, exposing the extensor tendons. In addition to this, there developed during the third week an osteomyelitis of the shaft of the fourth metacarpal and a suppurative tenosynovitis of the ring finger flexor tendon sheath. When the latter was opened, the tendons were found necrotic and were excised. Blood culture on the third postoperative day revealed streptococci, while all succeeding ones were negative. Under Carrel-Dakin treatment all the wounds rapidly became clean. During the fifth week, a thin shell of bone sequestrated from the dorsal surface of the fourth metacarpal bone, following which the extensive wound on the dorsum of the hand began to granulate and soon covered over the exposed extensor tendons. A few Thiersch grafts helped materially to hasten epidermization. As soon after the original operation as the patient was physically able, active motion in the hand, wrist, elbow and shoulder joints was instituted. Massage was started after the discharge from the wounds had ceased. This was supplemented by baking and mechanicotherapy at a later date. Figures 17, 18, 19 and 20 represent the condition at the end of 11 months and demonstrate the free mobility in the wrist, elbow and shoulder. The ring finger is inactive as a result of tendon necrosis. Motion in the interphalangeal joints of the other fingers is normal, but there is restriction amounting to 50 per cent at the metacarpophalangeal joints, presumably due to dense adhesions between the extensor tendons and the scar on the back of the hand. In spite of this, the patient's grip is excellent and he has resumed his former occupation.

From the standpoint of end-results, therefore, these cases can be summarized as follows: One patient died. One recovered with restoration of complete function. The remaining 2 present fair anatomic and functional results, but both patients have been able to resume their former occupations without any decrease in earning power.

CONCLUSIONS

From the foregoing analysis of 460 hand infections, it would seem justifiable to draw the following conclusions:

1. The vast majority of simple abscesses of the hand are, as a rule, easily recognized and and may be treated adequately. The occasional case of abscess over the site of a clearly defined anatomical synovial compartment or fascial space often offers considerable difficulty in differential diagnosis. Recognition of the importance of minor signs would seem to tend to overcome this difficulty.

2. Localized cellulitis of the digits and hand often simulates closely the more severe infections of the tendon sheaths or fascial spaces. As conservative treatment practically always results in a cure and as unnecessary incisions usually aggravate the conditions present, it becomes imperative to study most carefully the various symptoms and objective findings in each individual case so that a positive diagnosis may be arrived at.

3. Isolated abscess of the web spaces is not an infrequent form of hand infection. The physical signs are distinctive and, to secure adequate drainage the web may be split from front to back, for no untoward sequellæ followed this procedure.

4. The successful treatment of collar-button abscess depends mainly upon the recognition and isolation of the tiny sinus connecting the superficial and deep pockets. The latter is very often the more extensive of the two. The results in this group are most satisfactory, 2 out of the 42 in this series presenting slight permanent anatomical defects.

5. Paronychia is probably more often unilateral than total. It is better apparently to treat these early infections radically than to await the more evident typical "run around." It is important to remember that, in the majority of instances (28 out of 42 cases here) the subungual region adjacent to the infected paronychium is also involved, requiring removal of the side and corner of the nail to secure proper drainage. The chronic cases, with fungus-like granulations extending from beneath the eponychium, yield to the radical operation or a Bier's hyperæmia for a short while.

6. Carbuncles are found on the dorsum of the hand and fingers, the pathology depending upon the anatomical peculiarities of the skin in this region. The successful treatment of this form of infection calls for the early recognition of the extent of pathology present and wide radical incisions with undermining of the skin flaps.

7. Felons may be either well localized, involving only a part of the anterior closed space,

or they may affect the entire space. The proportion in this series was 25 to 37 cases. Diagnosis usually offers very little difficulty. In the treatment, the important factors are the time for incising and the anatomical position of the incision. It would appear that the side incision offers the best chance for a symptomatic cure. Where a discharge continues after satisfactory drainage, the cause is usually to be found in an osteomyelitis of some part or whole of the distal phalanx. Twenty-one of a total 62 cases presented this complication. Depending upon the extent of involvement, recovery results with conservatism in the mild cases and removal of the necrosed portion in the more extensive ones. With the epiphysis untouched, regeneration of at least part of the diaphysis occurs more often than is generally realized. The reconstruction of deformed tender scars constitutes another phase of the later treatment.

8. Chronic localized superficial infections of the hand are not uncommon. While the staphylococcus aureus is the most frequently cultured organism, the cause for the failure to heal is to be found locally and is, as a rule, thermal, mechanical, or chemical. Removal of the cause will, in the majority of cases, bring about speedy recovery.

9. Suppurative tenosynovitis of the flexor tendon sheaths should be considered a major surgical condition. In its successful treatment the ingenuity and patience of the surgeon are frequently taxed to the utmost. When the subject is carefully analyzed, it appears that, until our knowledge of the anatomy, physiology, and pathology of the tendons and their sheaths is more perfect, the best end-results can be obtained by (a) an early diagnosis made possible by proper evaluation of physical signs; (b) early operation, preferably during the first 24 hours; (c) performing the operation in a bloodless field with the patient under general anæsthesia; (d) the use of properly placed and sufficiently long primary incisions; (e) making every attempt to avoid secondary contamination and infection during the postoperative period; (f) reducing the use of drainage material to a minimum; (g) the early employment of active and passive motion and, later, of other physiotherapeutic remedies and devices; and (h) maintaining an attitude of constant close attention to details until treatment has been terminated.

The possibility of extension to the various bursæ and fascial spaces must be borne in mind and, when involved, they also are treated along the same lines. The immediate and late results of tenosynovitis, in the last analysis, depend upon the ultimate fate of the involved tendons. Of 42 cases here reported, 30 sloughed some part or the whole length of one or both tendons, a percentage of 71.4. An examination of Table II shows graphically the reason for this. Accepting the principles of treatment as outlined, results can be improved only by early diagnosis and operation.

10. Suppurative ulnar bursitis follows either a tenosynovitis of the little finger or an extension from the radial bursa, the latter occurring in 33.3 per cent of the cases in this series. Diagnosis is not difficult when the history and previous pathology are known and when the various objective findings are carefully evaluated. The treatment calls for properly placed adequate incisions both in the hand and above the wrist and the application of the same principles outlined under suppurative tenosynovitis. To secure free drainage in particularly virulent cases, the anterior annular ligament may be split. No untoward results followed this procedure. When the infection extends beyond this sac, in the hand the middle palmar space or the radial bursa or both become infected and in the forearm, the deep spaces become involved. Great difficulty is experienced in attempting to analyze end-results because of their direct bearing on the outcome of the infection in associated anatomical regions.

11. The observations recorded above apply equally as well to suppurative radial bursitis. Radial bursitis frequently follows traumatic amputations of the thumb. In making the incision, every effort should be made to avoid injuring the intrinsic muscles of the thumb so that the important apposing action may be preserved. It is rarely, if ever, necessary to split the annular ligament, for the upper end of the bursa can be thoroughly drained through the external lateral incision above the wrist.

TABLE I.—INDICATING THE INCIDENCE OF EXTENSION OF INFECTION FROM TENOSYNOVITIS OF THE FINGERS IN THIS SERIES

Secondary Extensions	Thumb 6 Cases	Index Finger 8 Cases	Middle Finger 9 Cases	Ring Finger 7 Cases	Little Finger 12 Cases
Radial bursa	4				4 following ulnar bursa
Thenar space	4	3			
Ulnar bursa	4 following radial bursa				8
Middle palmar space			2	3	2

TABLE II.—DEMONSTRATING THE RELATIONSHIP BETWEEN ONSET OF SYMPTOMS AND OPERATION AND SUBSEQUENT TENDON NECROSIS OR RECOVERY. IT EMPHASIZES THE NECESSITY OF EARLY DIAGNOSIS AND OPERATION

Time of Operation after Onset of Symptoms	Number of Cases	Number of Sloughing Tendons	Extension beyond Tendon Sheath	Number of Good Results	Number of Fair Results	Number of Poor Results
Within 12 hours	3	0	0	2	1 adhesions	0
12 to 24 hours	7	1	3	4	2	1
24 to 48 hours	10	7	7	0	3 no sloughing	7
48 to 72 hours	17	17	12	0	0	17
After 72 hours	5	5	4	0	0	5

TABLE III.—INDICATING THE PATHS OF EXTENSION FROM RADIAL AND ULNAR BURSITIS. IT SHOULD BE UNDERSTOOD THAT THE SAME CASE MAY HAVE SIMULTANEOUS INVOLVEMENT OF TWO OR MORE OF THE SYNOVIAL SHEATHS OR FASCIAL SPACES

	Ulnar Bursa 12 cases	Radial Bursa 10 cases
Ulnar bursa	0	4
Radial bursa	4	0
Middle palmar space	3	0
Thenar space	0	4
Deep abscess of forearm	5	4

The end-results depend mainly on the outcome of associated infections.

12. Thenar space infection is a most characteristic entity. The predominant diagnostic feature is the excessive ballooning out of the thenar eminence. Accepting the anatomical outline and limits of this space, treatment consists mainly in making the incision advocated by Kanavel. A complete restoration of function can be expected in every uncomplicated case.

13. The diagnosis of infections of the midpalmar space should rarely offer any great difficulty. The outstanding single objective finding is the replacement of the normal concavity of the palm by a convexity. Bearing in mind the anatomical boundaries and position of this space, the reason for using the incision recommended becomes apparent. In the great majority of uncomplicated cases there is every reason to expect an excellent end-result—80 per cent in this series. In other cases, the final outcome appears to be influenced by infections present in adjacent tendon sheaths and bursæ.

14. The important facts determined by an analysis of the deep forearm abscesses were (a) that they were caused by extension from a pre-existing radial or ulnar bursa infection; (b) that the pus was situated deep to the flexor tendons; (c) that satisfactory drainage could be obtained only by the side incisions; and (d) that the final results were generally satisfactory.

15. Suppurative tenosynovitis of the common extensor tendon sheath is an uncommon condition. While not pathognomonic, the outstanding signs and symptoms are inability to flex the fingers and the absence of positive findings on the anterior aspect of the hand. Simple splitting of the sheath seems to form the basis of treatment. It is interesting to note that

necrosis of the extensor tendons occurs rarely. The number of good late results is thereby greatly increased.

16. Osteomyelitis of the proximal or middle phalanges usually follows incompletely drained flexor tenosynovitis. The proximal interphalangeal joint is very often also involved. The course of treatment followed will depend upon the extent of the disease, various cosmetic and economic factors and the progress of associated infections and will range from simple conservatism to amputation.

17. Infection of the palmar fascia is a rare condition, evidencing definite pathological findings and caused usually by the staphylococcus aureus. Treatment is simple and consists of incision with removal of the necrosed fascia. The results are good.

18. Phlegmonous lymphangitis is a severe lymphatic infection on the dorsum of the hand, forearm and often the arm, accompanied by necrosis of the subcutaneous tissues, superficial fascia and, sometimes, large areas of skin. Marked systemic symptoms manifest themselves and are often severe enough to overwhelm the patient. Adequate drainage through multiple incisions, maintenance of the fluid level of the body, the use of the Carrel-Dakin technique and transfusions are the main factors in treatment.

19. The intelligent treatment of hand infections demands a knowledge of the anatomy of the hand and the various pathological processes that may exist. Every effort should be made to obtain the best result possible, for the hand, from the economic, social and cosmetic standpoints, is one of the most important organs of the human body.

VASCULAR TUMORS OF THE INTESTINE[1]

By ALFRED J. BROWN, M.D., F.A.C.S., Omaha, Nebraska

BENIGN tumors of the intestinal tract are of comparatively rare occurrence and of the various forms of benign tumor a vascular tumor is one of the least frequently encountered. Reported cases are few and far between; antemortem diagnosis is unusual; and exact pre-operative diagnosis, except in those cases in which the growth involves the rectum and is visible, is unknown.

CASE REPORT

The patient, a girl of 12 years of age, was referred to me by Drs. Sandusky and Lee, of Seward, Nebraska. She had been well up to the onset of the present trouble except for an occasional intestinal upset during the past few months. At these times she said she had some abdominal distress but did not vomit or have any other symptoms. The attacks were so slight that the mother thought nothing of them. On the day of admission about half an hour after a heavy noon-day meal she complained of sudden sharp pain in the abdomen and vomited. The pain was cramp-like in character and situated low in the abdomen and the vomiting continued. At first the vomitus consisted of stomach contents and in the course of a very few hours it became stercoraceous. The following morning, the child looked very sick. Constipation had been absolute after a first small movement following an enema and the vomiting was continuous, every few moments. Her face was drawn and pinched. The abdomen was moderately distended but no visible peristalsis could be seen. The muscles were soft except for slight rigidity of the lowermost portions of the recti. No tumor mass could be felt by abdominal palpation. Rectal examination revealed a doughy feel to the finger, so much so that she was catheterized in spite of the fact that she had voided a short time previously, but only a small amount of urine was obtained. The leucocyte count was just over 25,000 and the polymorphonuclear cells over 80 per cent. From subsequent knowledge this was evidently a dehydration leucocytosis. The temperature was 99 degrees with pulse of 120 and respirations slightly increased.

From the examination and findings a diagnosis of either fulminating appendicitis or intestinal obstruction was made and immediate operation advised Under ether anæsthesia a rather long incision was made just to the right of the mid-line of the abdomen having the umbilicus as its center. The small

[1] Read before the Western Surgical Association December 7, 1923.

intestine was ballooned up to about four times its natural size and its wall markedly thinned. The pelvis and lower abdomen contained a considerable quantity of serosanguinous fluid and lying deep in the pelvis was a tumor that felt like the proverbial bag of worms spoken of so often in describing varicocele. When this was delivered from the abdominal wound it was found to be in the small intestine. The exact location with reference to the duodenum was not noted as I did not want to lose any time; but from the character of the symptoms, the undigested content of the bowel just above the site of constriction, and the small amount of distention showing from without compared with the very great distention of the intestine above the constriction found after opening the abdomen, I would judge it was rather high in the jejunum. Eight inches of gut containing the tumor was resected and an end-to-end anastomosis performed. Following operation acute gastric dilatation supervened, vomiting continued, and death occurred 2 days later. An autopsy was refused.

The tumor was 5 inches in length, annular in form, and involved the entire circumference of the intestine. Its longest measurement was at the junction of the mesentery with the gut, though the mesenteric vessels were not involved. From this broad area its margin passed diagonally across the gut on either side until at the area of gut opposite the mesenteric border it was only an inch in length and here the dilated veins of which it was made up were smaller than near the mesentery. The dilated blood spaces of which the tumor was composed were raised from the surface of the gut and were of a dusky violet color. The margins were rather sharply demarcated and raised above the surface. In the original state, with the sinuses engorged with blood, this elevation amounted to a quarter of an inch at the margin of the tumor and half an inch at its thickest part. Near the periphery of the gut opposite the mesenteric border were three phleboliths. The finger introduced into the lumen of the gut met a constriction which would not admit the tip of the finger and the intestine above this constriction contained almost entirely undigested food. When the gut was split longitudinally the constriction was found to be due to a collection of fibrous tissue around the dilated sinuses at the thickest portion of the tumor. Toward the periphery the dilated sinuses could be seen beneath the mucosa and the mucosa was elevated but was otherwise normal. On section the tumor consisted of irregular sinuses lined with endothelial cells and containing large numbers of red blood cells. The greater number were situated in the submucosa and the mucosa was nowhere involved. In some areas the sinuses had insinuated themselves between the muscle bundles and some appeared beneath the serosa. Histologically the tumor was a cavernous hæmangioma.

Rokitansky (22) mentions a blood vascular new-growth of the intestine but his ideas were evidently not clear cut on the subject. In the English translation of his work published in 1855 he mentions vascular tumors in connection with both stomach and intestine. Regarding the stomach, he writes: "Erectile tissue is either developed in the free end of polypi, or the mucous membrane degenerates into it on a larger surface, upon which the erectile tumor is attached by a broad base, or only by a very short neck or stalk. It is the common seat of encephaloid infiltration." Under tumors of the intestine, he states: "Erectile tissue occurs as a pediculated polypus (mucous or cellular polypus), or in the shape of large, broad, sessile tumors, chiefly as the consequence of catarrh in the colon and rectum. It may in this case also be the seat of medullary carcinomatous infiltration." Rokitansky appears to consider the tumors as the result of inflammation and as prodromata of malignancy. Six years later (23) in discussing the subject he does not mention vascular tumors of the stomach and under the heading, intestine, states that vascular tumors are of the greatest rarity ("Hoechst seltenen Faellen") and when found consist of telangiectases of the intestinal mucous membrane.

Longuet (16) in 1898 cites three cases, and notes the rarity of the occurrence of angiomata of the intestine and considers one of the three cases he tabulates not an authentic case. He fails to include Gascoyen's (8) case which is the first one reported.

Heurtaux (12) in 1900 calls attention to the rarity of the condition and abstracts the three cases already cited by Longuet.

MacCallum (17) in 1906 reviews five cases and adds a sixth from the Johns Hopkins Hospital Pathological Department.

Dewis (6), 1906, in a review of benign intestinal tumors calls attention to the rarity of angiomata and states that he has been able to find reports of only three cases. He adds no new cases.

King (14) in 1917 notes the rarity of angioma of the bowel and states he could find imperfect records of but 3 cases. A fourth case referred to by Louenstein as a case of Nicoll's could not be found. King calls attention to the fact that Longuet considers one of the cases doubtful. Heurtaux' table is given and does not contain Gascoyen's case.

Judd and Rankin (13) in 1922 confine their paper to vascular tumors of the stomach and duodenum and report an angioma of the duodenum.

Helvestine (11) in 1923 reports 14 cases collected from the literature and adds another found at autopsy. He classifies the tumors as either simple or cavernous angiomata and states that the growth may begin either in the subserous, intramuscular or submucous plexuses of the intestinal walls, the submucous plexus being the most common site of origin.

In a rather careful search, I have been able to find but 19 cases of vascular tumor of the intestinal tract below the stomach. These include all forms of vascular tumor varying from capillary nævi to cavernous angioma. Brief abstracts of the cases are given:

Case 1. Gascoyen (8). The patient, a man of 44, died as the result of a nævus involving the parotid gland which caused death from suffocation. There were numerous other nævi over the body and limbs forming tumors of greater or less size. There were also nævi of the viscera: . . . "In the case of the small intestine having a nævus visible, beneath its peritoneal coat, the growth had originated in the submucous cellular tissue and projected considerably into the cavity of the bowel, but the mucous membrane covering was still entire."

Case 2. Laboulbene (15). The patient, a man of 64, suffered from an attack of blood in the stool. One month later he again passed blood in the stool and also vomited black clotted blood. The hæmorrhage recurred a few days later and the patient died. Postmortem revealed an elevated tumor about the size of an almond in the duodenum above the papilla of Vater. The mucosa was the site of a ragged ulcer which exposed the tumor. On section it was found to be made up of dilated capillary spaces.

Case 3. Boyer (4). Male, aged 62, died of pneumonia. Paralysis on right side for 3 years. No intestinal symptoms. About six feet of the free border of the lower jejunum and upper ileum showed small rounded dark spots visible when the gut was held up to the light. These were attached to the vascular arterial arcades of the gut. They were very numerous, probably 50 on 20 centimeters of the surface of the gut. The tumors are attached to the arteries and appear like injected renal glomeruli. They were continuous with the arteries and each had an imperfect elastic fibrous envelop.

Case 4. (Paci, 21, quoted by MacCallum.) A woman, after suffering from symptoms of intestinal obstruction, passed a cavernous tumor which had been the site of a hæmorrhage into its substance and its pedicle had parted allowing it to be passed. The central portion of the tumor was composed of cavernous tissue. Recovery took place.

Case 5. Marsh (18) reports a case of a girl, aged 10, who since 2 years of age had suffered from continuous and sometimes severe intestinal hæmorrhages. A nævoid growth was seen by speculum in the lower rectum completely surrounding the gut. Paquelin cautery relieved but did not cure the condition.

Case 6. Barker, E. T. (1), describes a case of nævus of the rectum in an adult. The patient, a healthy man, developed diarrhœa and hæmorrhage. The mucous membrane of the rectum was blue and ulcers developed which bled freely. The bleeding continued, a stricture formed, and the patient died of anæmia. Postmortem: The lower four and one-half inches of the rectum was thickened by a nævoid growth in its walls and on the rugæ were the three shallow ulcers described.

Case 7. Delbet (5). The patient was a woman, 21 years of age, who gave a history of long continued intestinal disturbance. She was emaciated, the abdomen large, and there was marked visible peristalsis and signs of ascites. The chronic intestinal obstruction grew worse. At operation no free fluid was found. The small intestine was markedly distended down to the site of a growth which surrounded the intestine like a ferrule and protruded 3 centimeters above the surface. Resection was performed and the tumor was found to be an angioma. The caliber of the gut was so reduced that it hardly admitted the tip of the finger. The patient died following the operation.

Case 8. Nicoll, James H. (19). The patient was a woman of 23 years who suffered from pain, hiccough, eructations, persistent vomiting and absolute constipation. A fortnight previously, she had had a similar but slighter attack and during the fortnight had had pain in the epigastrium coming on shortly after meals and lasting for an hour. At operation a double intussusception was found. About five feet of intestine was resected and in the gut just above the intussusception was a tumor about the size of a pigeon's egg. An end-to-end anastomosis was performed and the patient recovered. Histological report: "There are large, thin-walled spaces filled with coagulated blood and the tumor is typically nævoid. It contains two small phleboliths each the size of a split pea. Its size is that of a pigeon's egg. One surface is covered with peritoneum and the other, the internal, with villous mucous membrane."

Case 9. Hektoen, L. (10). Male, 48 years, died of chronic aortitis and mitral endocarditis. The upper third of the small intestine shows many large vessels running under the mucous coat, transversely to the long axis of the gut and parallel one to the other, giving the mucous membrane the appearance of being the site of varicose veins. Smaller vessels present numerous nodular enlargements, all of which are full of blood and project beneath the mucosa. The mucous membrane is normal. There are no

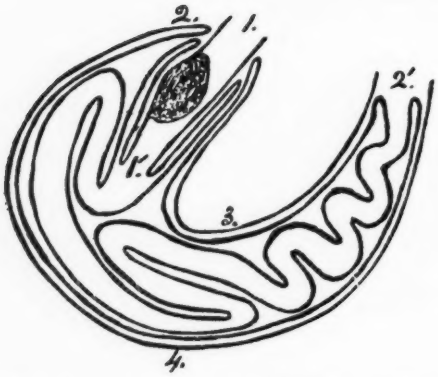

Fig. 1. Vascular tumor causing double intussusception. Diagram of section of gut. Case 8, Nicoll.

changes in the veins of the mesentery or other parts of the abdominal viscera. Microscopic examination shows the tumor to be composed of abnormally numerous and abnormally enlarged veins with saccular and globular dilatations.

CASE 10. MacCallum, W. G. (17). The patient was a white male, aged 54 years, who complained of digestive disturbances for months. Two years before he had vomited blood. He was alcoholic. There were small, firm, purplish nodules throughout the small intestine, best seen by transmitted light. They were scattered along the veins and connected by abundant branches with the larger veins. Sections show these nodules to be vascular tumors of cavernous structure composed of wide sinus-like spaces lined by endothelium and full of blood. They lie in the submucosa, not invading the mucosa and in but few places found in the musculature.

CASE 11. Benneke, H. (2). The patient, a man of 52 years, died of tuberculous meningitis. In the submucosa of the entire gut from œsophagus to rectum were many small, brownish red masses. There were also masses on the under lip. There were no hæmorrhoids.

CASE 12. Ohkubo, cited by Helvestine (20). The patient, a woman 62 years of age, died of pneumonia. At autopsy there were found many varices in the submucosa of the jejunum.

CASE 13. Ohkubo, cited by Helvestine (20). The patient, a man of 79 years of age, died of pneumonia. At autopsy there were many small nodules of a red color in the submucosa of the small intestine. They projected into the lumen of the gut but the mucosa over them was unchanged. Microscopically they were cavernous angiomata.

CASE 14. Tuffier (24). The patient, a man of 37, had had intestinal hæmorrhages since the age of 7 years. He passed about a tumbler of bright red blood at a time. After each attack, rest in bed relieved him temporarily. Tuffier found by sigmoidoscopic examination a small purplish lump the size of a pea, 22 centimeters above the anus. The surface was ulcerated. It was cauterized and the patient improved for a time. Then the hæmorrhages recurred. Abdominal operation revealed no mass. At autopsy two small angiomata were found in the sigmoid. They were in the submucosa and the mucosa over them was normal.

CASE 15. Hartmann (9). The patient, a woman of 22 years of age, was thought to have hæmorrhoids. Hartmann found a small angioma which was accessible by proctoscopic examination. Electric cauterization cured the condition.

CASE 16. Dujarier and Topous Khan (7). The patient, a man had been suffering from occasional rectal hæmorrhages for 3 years. Abdominal operation showed numerous cavernous angiomata of the sigmoid, and marked varicosities of the veins.

CASE 17. Judd and Rankin (13). The patient, a woman of 22 years of age, had suffered from nausea and epigastric distress for years. The attacks were brought on by dietary indiscretion. They occurred about two hours after meals and were relieved by vomiting. The X-ray showed a shadow which appeared as a ring with translucent center. Operation showed a thick walled, dilated stomach. On the duodenal side of the pylorus was a rounded tumor filling the duodenum. The tumor was enucleated by an incision in the mucous membrane. Histologically the tumor consisted of a mesh of fine capillaries with a few dilated sinuses supported in a highly cellular framework. The growth was apparently a rapid and recent process.

CASE 18. Helvestine (11). The patient, a female mulatto aged 72, died apparently of a terminal pneumonia. There is a pedunculated tumor on the external surface of the jejunum, 27 centimeters from the pylorus. Neither the peritoneum nor mucosa are involved. It is definitely encapsulated and consists of a central spongy mass and a cystic cavity containing a brownish fluid and a small amount of grumous material. Histologically there were large endothelial lined spaces containing erythroblasts. The blood spaces were separated from each other by a dense connective tissue stroma. Helvestine considers the tumor a cavernous hæmangioma which is undergoing retrogression.

CASE 19. Bland, M. E., Mashke, A. S., and Karsner, H. T. (3). The patient was a girl two months of age who had persistent and continuous vomiting for 4 days. There was fæcaloid vomiting and absence of stool. On examination abdominal distention, prominent abdominal veins, and visible peristalsis were noted. At operation a tumor was found in the ileum about 18 centimeters from the ileocæcal valve. An ileostomy was performed but death occurred the following day. At autopsy a tumor was found 30 centimeters from the ileocæcal valve. The diameter of the gut at the tumor area was 3 millimeters. Microscopically the tumor was found in the mesentery and all walls of the intestine except the mucosa. The tumor was arranged in lobules. Its cells were large and round, oval or spindle,

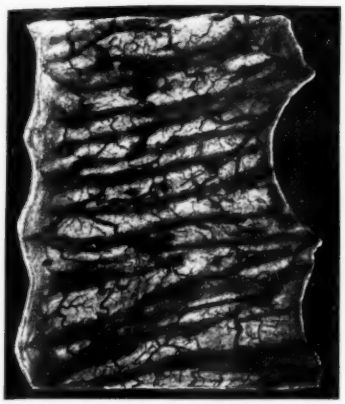

Fig. 2. Angiomata scattered along blood vessels. Viewed by transmitted light. (Case 10, MacCallum, *Johns Hopkins Hosp. Bull.*)

arranged to form capillaries. The capillaries were closely opposed and formed irregular whirls through the lobules. The cells were of endothelial character. Certain lobules showed few or no capillaries. The tumor was obviously a capillary hæmangioma. The authors classify it as hæmangio-endothelioma and group it with the intravascular or simplex class rather than with the peritheliomata.

A study of the twenty cases collected reveals the following:

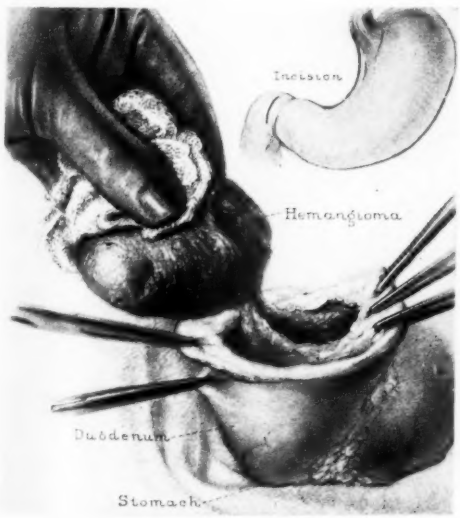

Fig. 3. Drawing showing the method of removal of angioma of duodenum. (Case 17, Judd and Rankin, *Ann. Surg.*)

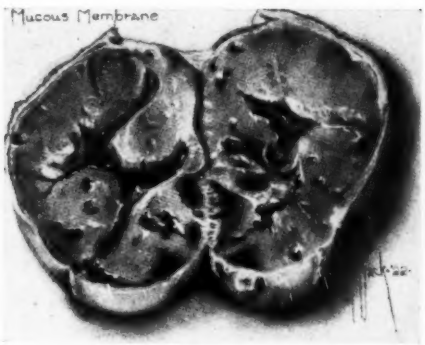

Fig. 4. Angioma of duodenum laid open. (Case 17, Judd and Rankin, *Ann. Surg.*)

Sex. Classification as to sex shows the cases to be evenly divided; 10 being in males and 10 in females. Considering the symptoms with the sex shows that of the 7 cases in which there were no symptoms, 5 were in males and 2 in females. It is interesting to note that all the cases showing intestinal obstruction, 5 in number, were female patients while five of the 6 patients exhibiting hæmorrhage as the prominent symptom were males.

Age. The age of the patients varied from two months to 79 years. Those giving symptoms during life varied from two months to 64 years.

Number of tumors. In 12 cases the tumor was single; in 8 there were multiple tumors, the number varying from two to hundreds.

Part of intestine involved. In 2 cases the tumor was in the duodenum. In 11 the small

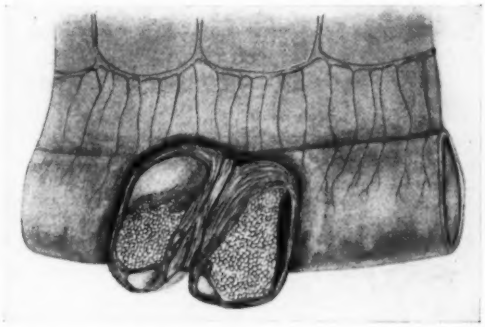

Fig. 5. Drawing representing hæmangioma of the duodenum which has been sectioned to show the interior. (Case 18, Helvestine, *Ann. Surg.*)

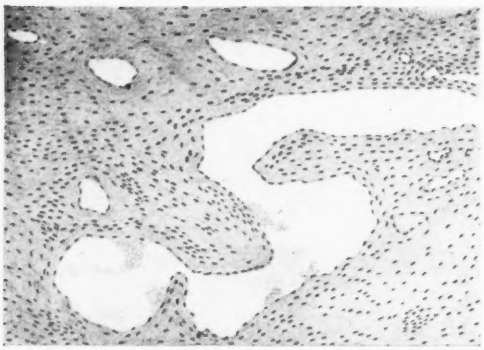

Fig. 6. Microscopic section of fibrous portion of angioma of jejunum. (Case 18, Helvestine, *Ann. Surg.*)

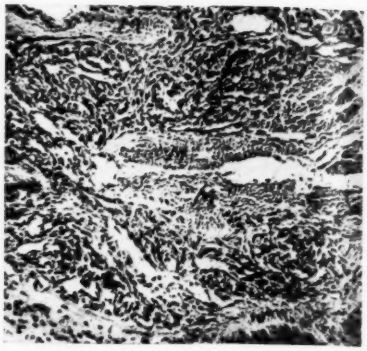

Fig. 7. Photomicrograph of capillary tumor of ileum. (Case 19, Bland, Mashke, and Karsner, *Am. J. Dis. Child.*)

intestine was the site of the growth. In 3 cases the sigmoid was involved and in 2 of these the growth was multiple. In 2 cases the tumor was in the rectum. In one patient the entire intestinal tract and even the lower lip was involved. In one case, that in which the tumor passed spontaneously, the site was unknown.

Gross character of tumor. Five of the tumors were diffuse, 7 were encapsulated, and in 8 cases no statement as to this characteristic was reported. In 3 cases there was ulceration of the mucous membrane over the surface of the tumor. In the remaining 17 cases the mucosa appeared normal even though in 3 of these hæmorrhage had been a symptom.

Symptoms. Seven of the cases gave no symptoms. Of the remaining 13, 6 suffered from gastric or intestinal hæmorrhage, one from nausea and epigastric distress with vomiting after eating (evidently very early high partial obstruction) one from chronic intestinal obstruction, 4 from acute intestinal obstruction, and in one case the symptoms were not given. Of the acutely obstructed cases, one was relieved by the spontaneous passage of the tumor; in one the tumor caused an intussusception and in the other 2 the tumor itself caused obstruction by constricting the lumen of the gut.

Part of wall giving rise to the tumor. In all cases in which any statement was made, the tumor arose in the submucosa. From this point it tended to invade the muscular coat even to a point beneath the peritoneum. The peritoneal coat in all cases remained intact. In 3 cases the mucous membrane was ulcerated, but the mucous coat was apparently not involved by the tumor itself. In one case only did the tumor invade the mesentery.

Histology. The histological reports, though not detailed in all cases, would tend to show

Fig. 8. External surface of cavernous angioma of small intestine.

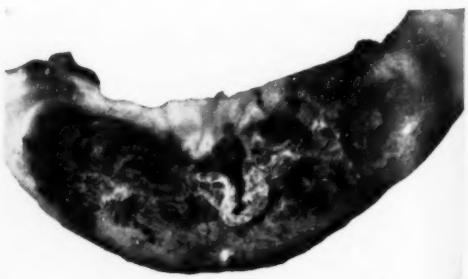

Fig. 9. External surface of cavernous angioma of small intestine.

Fig. 10. Intestine split along mesenteric border and flattened out to show entire extent of the tumor on the external surface of the gut.

Fig. 11. Intestine split to show mucous surface. Note the constriction caused by the thickening of the tumor at its center.

that the tumors range from capillary nævi to cavernous angiomata.

In general, from a study of these 20 cases, vascular tumors of the intestine may be grouped into four classes:

1. The multiple tumor on the vascular arcades. These appear as small red nodules, situated in the submucosa and connected with either the arteries or veins of that portion of the intestinal wall. They are best seen by transmitted light when they appear as above noted. Microscopically they are either nævi or cavernous angiomata. MacCallum's patient had suffered from vomiting of blood on two occasions. It would appear to be a difficult matter, however, to attack tumors of this character surgically with any hope of relieving the patient. They are very numerous in the cases reported and the site of hæmorrhage would be almost impossible to find.

2. The submucous tumor which grows toward the lumen of the gut and may ulcerate the overlying mucosa by pressure and trauma. The 3 cases of this type were all fatal. In one an operation was performed and the tumor not found as it was situated in the sigmoid. In one the tumor was a single nodule in the duodenum above the papilla of Vater with a ragged ulcer on its surface which might have been reached and removed by operation. It would appear that the possibility of the existence of this form of tumor might well be borne in mind when seeking the cause of obscure intestinal hæmorrhage.

3. The submucosal tumor which may grow to such a size that it either obstructs the lumen of the gut or causes a change in normal peristalsis and brings about intussusception. This type of tumor has been successfully dealt with surgically in two instances. In a third case the tumor was spontaneously evacuated with recovery. The possibility of the presence of this type of growth might well be remembered when seeking the cause of intestinal obstruction.

4. The diffuse ring-like tumor which beginning in the submucosa, involves the muscu-

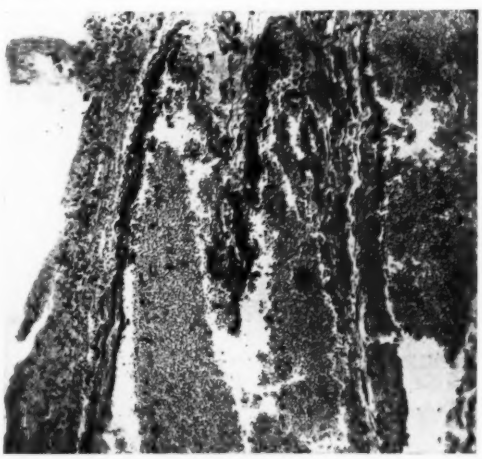

Fig. 12. Photomicrograph of cavernous hæmangioma of the small intestine.

SUMMARY OF CASES THUS FAR REPORTED

Reported By	Date	Age	Sex	Single or Multiple	Site in Intestine	Portion of Intestinal Wall Involved	Symptomatology	Treatment Operative	Result	Cause of Death	Autopsy	Character of Tumor
Gascoyen	1861	44	M	S.	Small intestine	Submucosa and muscularis projecting into lumen of bowel	None		Died	Suffocation from Parotid Nævus	Yes	Nævus—visible beneath peritoneal coat. Originating in submucosa—projecting into the bowel. Mucosa not involved.
Laboulbene	1872	64	M	S.	Duodenum above papilla of Vater	Submucosa with ulceration of mucosa	Hæmorrhage. Blood in stool repeated		Died	Hæmorrhage	Yes	Dilated capillary spaces. Ragged ulcer of mucosa.
Boyer	1877	62	M	M.	Lower jejunum and upper ileum	Submucosa. Attached to vascular arcades	None		Died	Pneumonia	Yes	Attached to arteries, imperfectly encapsulated. Like renal glomeruli. Aneurysmal varix?
Paci	1882	Not stated	F	S.	Not known	Submucosa	Intestinal obstruction		Recovered. Spontaneous evacuation			Cavernous tumor. Pedunculated. Hæmorrhage into its substance.
Marsh	1898	10	F	S.	Rectum	Submucosa	Hæmorrhage. Blood in stool	Cautery	Relief			Nævoid growth completely surrounding the gut.
Barker	1898	43	M	S.	Rectum. Lower 4½ inches	Submucosa ulcerated	Hæmorrhage. Blood in stool		Died	Anæmia	Yes	Nævoid growth in walls of rectum. Three shallow ulcers on rugæ. Stricture.
Delbet	1899	21	F	S.	Small intestine	Submucosa and muscularis	Intestinal obstruction, chronic	Intestinal resection end-to-end anastomosis	Died	Obstruction		Annular angioma with stricture of bowel.
Nicoll	1899	23	F	S.	Small intestine	Submucosa	Intestinal obstruction acute. Intussusception	Intestinal resection, end-to-end anastomosis	Recovered			Large thin-walled spaces filled with coagulated blood. Tumor is definitely nævoid. Phleboliths. Double intussusception.
Heiztoen	1900	48	M	M.	Small intestine upper ⅓	Submucosa	None		Died	Chronic aortitis and mitral endocarditis	Yes	Abnormally numerous and abnormally enlarged veins with saccular and globular dilatations.
MacCallum	1906	54	M	M.	Small intestine	Submucosa invading muscularis	Hæmorrhage. Vomited blood. Long digestive disturbance in alcoholic patient		Died	Arteriosclerosis Bronchopneumonia	Yes	Vascular. Of cavernous structure composed of wide sinus-like spaces lined by endothelium and full of blood.
Benneke	1906	52	M	M.	Entire gut	Submusoca	None		Died	Tuberculous meningitis	Yes	Cavernous "phlebectasies."
Ohkuba	1907	62	F	M.	Jejunum	Submucosa	None		Died	Pneumonia	Yes	Varices.
Ohkuba	1907	79	M	M.	Small intestine	Submucosa	None		Died	Pneumonia	Yes	Cavernous angioma.
Tuffier	1913	37	M	M.	Sigmoid	Submucosa ulcerated	Hæmorrhage. Blood in stool	Exploratory laparotomy. Negative findings	Died	Not given	Yes	Angioma.
Hartmann	1913	22	F	S.	Rectum	Not stated	Not stated. Thought to have hæmorrhoids	Electric cauterization	Recovered			Angioma.

SUMMARY OF CASES—Continued

SUMMARY OF CASES—Continued

Reported By	Date	Age	Sex	Single or Multiple	Site in Intestine	Portion of Intestinal Wall Involved	Symptomatology	Treatment Operative	Result	Cause of Death	Autopsy	Character of Tumor
Dujarier and Topous Khan	1920	Not stated	M	M.	Sigmoid	Not stated	Hæmorrhage. Blood in stool	Exploratory laparotomy	Not stated			Cavernous angioma and varicosities of the veins.
Judd and Rankin	1922	22	F	S.	Duodenum	Submucosa	Nausea and epigastric distress. X-ray showed changes in duodenum	Local resection of the tumor	Recovered			Mesh of fine capillaries supported in a highly cellular framework. A few dilated sinuses.
Helvestine	1923	72	F	S.	Jejunum	Submucosa and muscularis	None		Died	Terminal pneumonia	Yes	Cavernous angioma undergoing retrogression.
Bland, Mashke and Karsner	1923	2 mos.	F	S.	Ileum	All walls of gut except mucosa. Also in mesentery	Intestinal obstruction. acute	Ileostomy	Died	Obstruction	Yes	Lobular capillary spaces formed by round, oval or spindle cells. Capillary hæmangioma.
Brown	1923	12	F	S.	Small intestine	Submucosa including muscularis	Intestinal obstruction, acute	Intestinal resection. End-to-end anastomosis	Died	Obstruction	No	Dilated spaces lined by endothelium, containing blood. Cavernous angioma.

laris and constricts the lumen of the gut bringing about an intestinal obstruction which may manifest itself either by a gradually increasing chronic obstruction or by an acute obstruction with sudden onset.

In only one case (that of Gascoyen) is there a suspicion that the tumor is more than a simple angioma. In this case there is the possibility that the intestinal tumor was a metastasis from the original parotid tumor. This is made more reasonable by the fact that there were similar tumors in other organs. In the remainder of the cases the tumor or tumors were localized in the intestinal tract and no cases of metastasis were reported. No case of recurrence after operative removal has been reported.

It seems hardly possible that angioma of the intestine is of as infrequent occurrence as the literature would seem to indicate and I would greatly appreciate the receipt of complete clinical reports of cases of this character, accompanied by microscopic slides, if possible, in order that the reported cases may be amplified and further study uncover more facts concerning the condition.

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PRE-OPERATIVE PREPARATION OF PATIENTS WITH OBSTRUCTIVE JAUNDICE

An Experimental Study of the Toxicity of Intravenous Calcium Chloride Used in the Preparation of Patients

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DURING the last 2 years in the Mayo Clinic, the intravenous administration of calcium chloride has become established as a routine step in the pre-operative preparation of patients with obstructive jaundice. That it is a factor in the reduction of the surgical mortality in this group of cases has been shown by one of us (Walters) in a report of the operative mortality for 1922.

The possible occurrence of toxic nephritis in the course of obstructive jaundice is generally accepted. The incidence of renal and hepatic insufficiency in these cases at the Mayo Clinic has been reported. The two may be easily differentiated, the renal insufficiency being associated with cessation of the drainage of bile, with evidence in the urine of a progressing nephritis, and with a steady rise of the blood urea level. This renal complication in postoperative convalescence has occurred in cases with and without a pre-operative course of intravenous calcium chloride. Renal insufficiency following the intravenous administration of calcium chloride naturally gave rise to the question of its toxicity. In this study we attempt to include or exclude intravenous calcium chloride as a factor in the production of such nephritis.

OUTLINE OF EXPERIMENTS

In the routine pre-operative preparation of patients with obstructive jaundice, a 10 per cent aqueous solution of calcium chloride is given intravenously, daily for three successive days, at the rate of 5 cubic centimeters for each 60 kilograms of body weight to patients within the normal range of adult body weight. Such a series of injections has been called a "therapeutic course," and this term will be used in this sense throughout the present discussion. Reducing this dosage to 1 unit for each kilogram of body weight, 8 milligrams of calcium chloride for each kilogram was administered to the dogs used in the study. All necessary surgical procedures on the animals were carried out under ether anæsthesia, and with the employment of sterile technique. The various steps of our investigation were as follows: (1) the rate of excretion of calcium chloride from the blood stream after its intravenous injection in various amounts, (2) the lethal dose of calcium chloride injected intravenously into normal and jaundiced dogs, (3) the effect on the kidneys of normal and jaundiced dogs of intravenous injection of calcium chloride, and (4) the effect on the hearts of normal and jaundiced dogs of intravenous injections of calcium chloride.

RATE OF EXCRETION OF CALCIUM CHLORIDE FROM THE BLOOD STREAM

The rate of excretion of calcium chloride from the blood stream after its intravenous injection in various amounts in normal and jaundiced dogs, when injected in 10 per cent solution, is dependent on the amount of solution injected. Following small doses of calcium chloride, such as the therapeutic dose (8.25 milligrams for each kilogram of body weight), it was observed that elimination from the blood stream occurs in from one-half to one hour. From 5 to 6 minutes after the injection, the blood calcium content in the normal unjaundiced dog was elevated 1 to 2.5 milligrams for each 100 cubic centimeters. After the same interval, the elevation in jaundiced dogs was from 0 to 1 milligram (Fig. 1).

Following the injection of larger doses, such as ten times the therapeutic dose (82.5 milligrams for each kilogram of body weight),

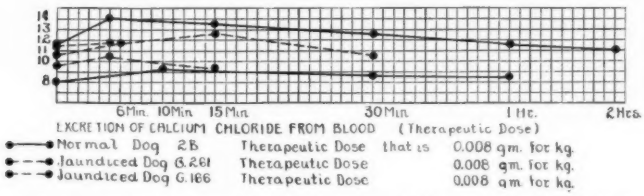
14
13
12
11
10
9
8
6Min. 10Min. 15Min. 30Min. 1 Hr. 2Hrs.
EXCRETION OF CALCIUM CHLORIDE FROM BLOOD (Therapeutic Dose)
Normal Dog 28 Therapeutic Dose that is 0.008 gm. for kg.
Jaundiced Dog G.261 Therapeutic Dose 0.008 gm. for kg.
Jaundiced Dog G.166 Therapeutic Dose 0.008 gm. for kg.

Fig. 1. Showing the curve of excretion from the blood of therapeutic doses of intravenous calcium chloride.

complete elimination from the blood stream occurs within approximately 4 hours. Five minutes after such an injection, the blood calcium content in normal dogs is elevated 14 milligrams for each 100 cubic centimeters; in jaundiced dogs 7.2 milligrams (Fig. 2). The latter observation is of considerable interest and lends itself to conjecture as to the ultimate fate of calcium injected into an animal with obstructive jaundice.

THE LETHAL DOSE OF CALCIUM CHLORIDE INJECTED INTO DOGS INTRAVENOUSLY

In spite of the many indications for the use of calcium, little exact information could be found in the literature on its pharmacological action when administered in doses sufficiently large to produce deleterious effects. Joseph and Meltzer have found 0.444 gram for each kilogram of body weight to be the lethal dose of calcium chloride injected intravenously in a solution in which the crystalline salt is in molecular solution, so that 4 cubic centimeters contain 0.444 gram. This solution was injected at the rate of 1 cubic centimeter a minute.

We have endeavored to determine the lethal dose of calcium chloride injected intravenously into normal and jaundiced dogs at the rate of 1 cubic centimeter a minute. An aqueous 10 per cent solution of calcium chloride was used (Table I).

It requires approximately twice the amount of injected calcium to raise the blood calcium content of the jaundiced dog to the same level as that of the normal dog; this, in spite of the fact that the blood calcium content is practically the same in the jaundiced and normal dogs before and after injection of a lethal dose, which suggests a calcium deficiency in the jaundiced animals which is not apparent.

TABLE I.—SUMMARY OF RESULTS OF LETHAL INJECTION OF CALCIUM CHLORIDE

		Wt., kg.	Lethal dose, mg. for each kg.	Times the therapeutic dose	Blood calcium		Mg. for each mg. increase in blood calcium
					Before injection	After death	
Normal dogs	G267	6.8	225.00	27.27	11.5	36.5	9.0
	28	10.7	287.85	34.89	10.3	42.0	8.82
Jaundiced dogs	G261	7.5	304.00	36.8	10.3	26.0	18.31
	G166	7.8	469.00	56.8	10.9	38.7	16.87

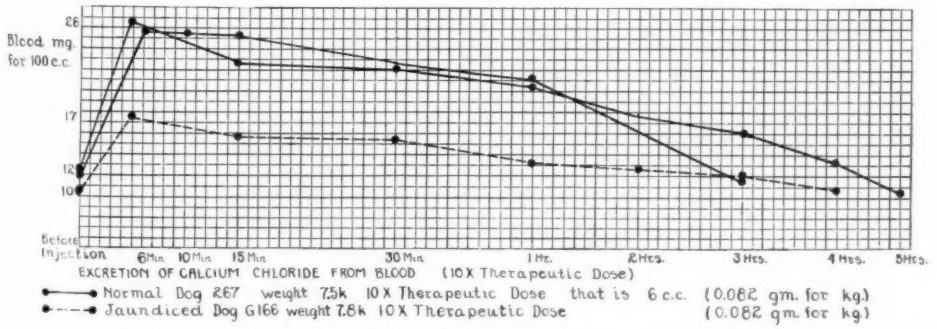
Blood mg. for 100 c.c.
22
17
12
10
Before Injection
6Min. 10Min. 15Min. 30Min. 1 Hr. 2Hrs. 3Hrs. 4Hrs. 5Hrs.
EXCRETION OF CALCIUM CHLORIDE FROM BLOOD (10X Therapeutic Dose)
Normal Dog 267 weight 7.5k 10X Therapeutic Dose that is 6 c.c. (0.082 gm. for kg.)
Jaundiced Dog G166 weight 7.8k 10X Therapeutic Dose (0.082 gm. for kg.)

Fig. 2. Showing the curve of excretion from the blood of ten times the therapeutic dose of intravenous calcium-chloride.

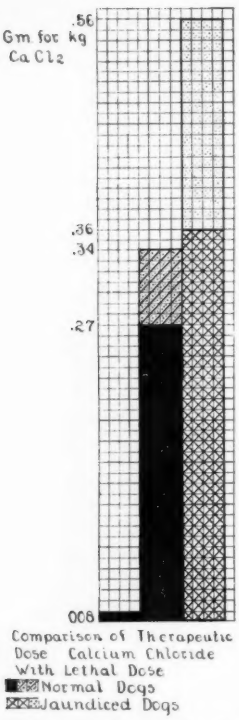

Fig. 3. Comparison of therapeutic dose of calcium chloride with lethal doses.

The results from our experiments of the lethal dose of calcium chloride show the amount to be considerably less than that reported by Joseph and Meltzer. Carrying out a technique of constant injection at the rate of 1 cubic centimeter a minute, we found the average lethal dose in normal dogs to be 256.4 milligrams for each kilogram of body weight. In jaundiced animals, 386.6 milligrams for each kilogram of body weight was the amount necessary to cause death (Fig. 3).

Necropsies were performed on the animals immediately after death. Sections were taken from the heart, liver, and kidneys.

THE EFFECT ON THE KIDNEYS OF NORMAL AND JAUNDICED DOGS OF INTRAVENOUS INJECTIONS OF CALCIUM CHLORIDE

Although not directly connected with the purpose of our experiments, a few of the many recent reports in the literature of investigations of the diuretic action of calcium are mentioned. MacCallum asserted that the quantity of urine secreted might for a time be markedly diminished, and in some cases almost entirely inhibited by the introduction of calcium chloride into the circulation. There is no evidence of such suppression with the doses or concentration of calcium salt used in the experiments of Mendel and Benedict, or in our own, which agrees with the work of Porges and Pribram, who conclude that the suppression of urine can be accomplished only by large doses of calcium chloride inducing a simultaneous fall in the blood pressure; when the salt is introduced in concentrations which leave the latter unaffected, calcium chloride exhibits a diuretic action. The latter effect has been investigated recently and confirmed by Blum, Aubel and Hausknecht, Barrier and Rockwood, Levy, and many others. Lowenberg, by ascertaining the doses necessary for the diuretic and the cardiotonic action of calcium chloride, has shown that the diuresis produced by calcium is not a result of its cardiotonic action. He found that doses of 0.1 to 1 gram have a manifest cardiotonic action, while its diuretic properties are exhibited only by doses greater than 1.5 grams.

In none of these discussions has a possible effect on the kidney been suggested. The fact remains, however, that in certain conditions such as bichloride of mercury poisoning and terminal pyelonephritis, calcium deposits have been found in the glomeruli and tubules of the kidney.

Six dogs were used in this experiment, three jaundiced as a result of ligation and section of the common duct, and three normal. The urine was examined daily before and after the injection of various amounts of 10 per cent calcium chloride intravenously. Blood urea estimations were made at various periods before and after injections of the calcium. From these animals and from all animals killed in the course of these experiments, the kidneys were removed at necropsy, sectioned and examined microscopically. We have been unable to produce deposits of calcium in the kidneys of dogs by doses ranging from 8 milligrams for each kilogram of body

weight to the lethal dose of 280 milligrams to 380 milligrams for each kilogram.

It was not possible to demonstrate a deleterious effect, clinically or pathologically, on the kidneys of these dogs, following intravenous injections of calcium chloride in amounts varying from 8 milligrams for each kilogram of body weight to the lethal doses.

THE EFFECT ON THE HEARTS OF NORMAL AND JAUNDICED DOGS OF INTRAVENOUS INJECTIONS OF CALCIUM CHLORIDE

The cardiotonic action of calcium administered intravenously has been mentioned in its possible relationship to the diuresis following calcium administration, in which it would seem to play no part. In administering calcium intravenously to patients, one is impressed with the usual quickening of the pulse rate and the sensation of flushing of heat over the entire body. These are temporary effects to which Hirschsohn and Maendl give the name of "dynamic effect" of intravenous administration. The same phenomenon was observed by them following the injection of quinine, dextrose, hexamethylenetetramin, and urea.

Dixon says that when the calcium salts are injected directly into the circulation, the heart beats more vigorously, the vessels constrict, and the blood pressure rises. The latter statement we have been unable to corroborate, as with the continuous administration of a lethal dose, given at the rate of 1 cubic centimeter a minute, there was no apparent rise in the blood pressure curve on the kymograph.

According to Cushny, soluble calcium salts injected directly into the blood vessels seem to be poisonous, their action resembling that of digitalis in some respects; they accelerate, and strengthen the heart beats, but in large quantities bring it to a standstill. We believe the mechanism which "brings the heart to a standstill" to be of considerable importance, and have undertaken its study because we could find no adequate explanation of it in the literature.

Throughout this part of the experiment, as before, 10 per cent aqueous solution of calcium chloride was injected at the rate of 1 cubic centimeter a minute, until the animal died. During the entire injection electrocardiographic tracings were made on each dog.

From our electrocardiographic studies it seems evident that the injection of toxic doses of 10 per cent solution of calcium chloride into the blood stream of a dog will produce various alterations in rate, disturbances of conduction, ectopic origins of impulse, and when carried to a still further point of toxicity, disturbances of the fundamental co-ordination of the heart and ventricular fibrillation, which is followed by death. Therapeutic doses have produced only alterations of the pulse rate.

The first and most striking effect is acceleration of rate. This has occurred consistently at an early point in the injection, but is produced by a smaller amount of the solution in the normal than in the jaundiced dogs. After the maximal acceleration is reached, there is marked variation in rate, after which the initial maximum is rarely exceeded. Conduction disturbances appear, marked by short, recurring periods of heart block, and notched QRS complexes, which make their appearance more frequently as the continued injection assumes a more toxic effect. At this point, there has occurred an increase in the amplitude of the T wave with its gradual encroachment on the QRS complex. This is rapidly followed by ventricular tachycardia, ventricular fibrillation, and death. Ectopic origin of impulses has been demonstrated by the appearance of inverted P waves and periods of nodal rhythm.

There was only one instance of an initial effect on the rate other than that of acceleration. On the rapid injection of 10 cubic centimeters this animal had a progressive slowing of the rate, followed by a persistent sinus bradycardia and the development of nodal rhythm. To investigate the possible rôle of the vagus in this result, both vagi of this dog were severed, two injections of 1/1500 grains of atropine were given subcutaneously, and the animal then subjected to the gradual injection of a lethal dose of calcium chloride. In this instance acceleration was produced. From this it might be hastily concluded that the initial slowing of the rate was the result

of vagus stimulation. On repeating this experiment with Dog 3B with the vagi severed, but without the administration of atropine to block the peripheral endings of the nerve, a result of acceleration, not of slowing was again obtained. That the absence of vagus conduction may be a factor in increasing the amount of calcium necessary to produce a lethal effect is possibly suggested by the fact that a dog, with the vagi severed, was able to withstand a larger amount of calcium in proportion to body weight, than a dog with vagi intact.

The rate at which the injection is given, producing a sudden concentration of calcium in the blood, seems to be a factor in the relative toxicity of any dose. In two instances, following rapid injections, the calcium content of the heart blood taken immediately after death was twice that of the blood taken from the external jugular vein.

As to the effect of intravenous calcium chloride on the blood pressure, no change was observed in the kymographic record on Dog 3B during the injection of 10 cubic centimeters of the 10 per cent solution. On severing the vagi of this animal the blood pressure rose immediately to a higher level, but fell gradually as the injection was continued to its toxic effect.

Death following large amounts of calcium has been commonly ascribed to calcium rigor or myocardial spasm. We ascribe it to the occurrence of ventricular fibrillation. Examinations of sections of the heart muscle microscopically show no evidence of segmentation, fragmentation, or other lesions.

DISCUSSION

The relation of calcium to body metabolism has been studied intensely in the past few years, particularly in relation to diseases based on a calcium deficiency of food or on diminished intestinal absorption. The administration of calcium as a hæmostatic agent, or more properly, as a means of increasing the coagulability of blood and lessening its coagulation time is likewise not a recent development, but it is still an open question whether calcium salts administered by mouth have such an effect. Wright and Paramore found a distinct difference within an hour or less; but Rudolph and Cole, after a very careful series of studies, have come to the conclusion that "the free exhibition of calcium lactate by mouth has no appreciable effect on the coagulation of the blood"; and Van Lier, after taking the coagulation time in forty persons before and after the administration of calcium lactate, has reached the same conclusion. Lee and Vincent, by the use of intravenous calcium solutions, reduced experimentally the prolonged coagulation time resulting from induced obstructive jaundice, and one of us has shown a definite and constant decrease in the coagulation time of the blood of patients suffering from obstructive jaundice following the intravenous injection of calcium chloride. Grove and Vines have reported effective control of hæmorrhage following the intramuscular injection of calcium chloride. Wright and Davies have reported its use as a styptic. Cushny says that the use of calcium salts as a local hæmostatic is a failure. The results obtained in the different methods of administration suggest that the need of the body for available calcium is the most important factor in the resulting effect on the coagulation time.

The value of intravenous calcium in the treatment of tetany has been emphasized by MacCallum and Voegtlin, Judd, and others. Meltzer has shown that toxic quantities of magnesium can be completely neutralized by calcium chloride.

Januschke, in 1910, demonstrated that pleural effusions may be checked by subcutaneous injection of calcium chloride, and Chiari found that transudation and œdema were favored by the removal of calcium, which normally serves to check the permeability of the vessels. These experimenters were able to check pleural effusion resulting from diphtheria toxin, and to reduce the conjunctival œdema resulting from the application of irritants.

Blum, Aubel, and Hausknecht, in a recent paper, cited three cases of ascites, the result of cirrhosis of the liver, and one case of diffuse œdema which persisted unmodified by the usual diuretics, in which calcium salts, administered orally, produced an immediate

reduction in weight and diminution of the ascites and œdema. When the administration of calcium ceased, the decline in weight stopped. They explain that the calcium seems to be eliminated by way of the bowel, and the chlorine by way of the kidneys. As the chlorine is freed from the calcium, it is forced to combine with the sodium; the sodium is then cast off, and with it the surplus of water. They assert that this antagonism between calcium and sodium is even greater than between potassium and sodium. Their usual dose was 11.1 grams of calcium chloride by mouth, but in some cases as much as 22 grams was administered. Barrier and Rockwood have been able to produce marked diuresis in patients with diabetes and nephritic œdema by giving large doses of calcium lactate by mouth.

According to Cushny, the soluble calcium salts are absorbed with great difficulty from the stomach and intestines, and retard considerably the absorption of fluid. The absorption is facilitated by the fatty acids with which they combine to form a soap of calcium, which is then more readily taken up by the surface epithelium. They would have a cathartic action, were they not thrown out of solution very readily by the alkaline fluids. The constipating effects of solutions containing calcium may also be due in part to the effect of the calcium salts, after their absorption, on the vegetative nervous system, the excitability of which they depress, and in part to their effect on the capillary vessels, the permeability of which they lessen. The great proportion of calcium taken either in the food or as a remedy, unquestionably leaves the bulk of the food in the stools entirely unabsorbed, while a small quantity of it is taken up from the alimentary tract, whether it be administered in a soluble or in an insoluble form. This small quantity circulates in the blood, probably in combination with proteins, and is slowly excreted, unless there is a deficiency in the supply of lime, when it may be utilized by the tissues. When larger quantities are thrown into the blood by intravenous or hypodermic injection, the calcium of the blood remains abnormally high for some time, but all the calcium thus injected is not in the circulation throughout its stay in the body. Some of it is deposited temporarily in an unknown organ, and is gradually withdrawn and excreted after the first excess is eliminated.

It has been generally conceded that only the smaller portion of absorbed calcium is eliminated through the kidney, the intestine taking the pre-eminent share in the excretory process. Mendel and Benedict, in an experimental study of the paths of excretion of calcium, showed that little reliance could be placed on the elimination data of the oral and subcutaneous administrations, as the injections were usually attended with local disturbances and the absorptive factor was entirely uncertain. Following the intravenous administration of calcium chloride in normal salt solution into the jugular veins of dogs, 15 per cent of the calcium was excreted by the kidneys within 3 hours, and 20 per cent within the first day. Diuresis followed the injection, not caused by the sodium chloride carrier, or by the volume of the injected solution as checked by later control experiments having to do with these factors alone. No noteworthy increase in the loss of calcium with the fæces was observed. In all cases in which the balance of calcium was determined, a marked retention was noted. The fact that the increased excretion by the kidney soon subsides speaks against a slow or gradual subsequent elimination in these cases.

CONCLUSIONS

1. Calcium chloride following its intravenous injection in a 10 per cent aqueous solution, is rapidly eliminated from the blood stream and shows no tendency to accumulation in the blood. Following therapeutic doses as used in these experiments, the blood calcium content returns to its normal level within 2 hours.

2. The lethal dose of calcium chloride administered intravenously in 10 per cent aqueous solution, at a uniform rate of 1 cubic centimeter a minute, was 256.4 milligrams for each kilogram of body weight in normal dogs; and in jaundiced dogs, 386.6 milligrams for each kilogram of body weight.

3. Following continued injections of calcium chloride, including therapeutic doses, in

normal and jaundiced dogs, no evidence of toxic effect on the kidney could be demonstrated, clinically or microscopically.

4. The cardiac effect of therapeutic doses of calcium chloride, as used in this study, is the production of various alterations in pulse rate. Toxic doses cause disturbances of conduction, ectopic origins of impulse, and when carried to the point of greater toxicity, ventricular fibrillation which is followed by the death of the animal.

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CHILDBEARING AFTER RADIUM AND X-RAY TREATMENT

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THE writer has been questioned so many times by physicians in regard to the danger of causing poorly developed, deformed, or backward children or even sterility in fertile women by the use of radium and X-ray for therapeutic purposes that it seems probable the known results are not common knowledge. These methods of treatment may be used during the childbearing age to relieve uterine bleeding caused by functional derangements of the ovary and fibromyomata which is not amenable to simpler measures. At present they are not used in the fibromyoma cases if a myomectomy is feasible because operation removes the pathological cause. Their effect is on the ovary, the uterus, and, in the case of radium especially, the endometrium. We may disregard the last two in this discussion because permanent changes are probably not produced in them if an artificial menopause is not brought on and they are not fundamentally concerned in fertility as are the ovaries.

Radiation may cause a temporary or permanent amenorrhœa or oligomenorrhœa. In the cases under discussion only a temporary amenorrhœa at the most is desired and the dosage is so regulated that it is rare to cause more than that. The cause of the amenorrhœa is generally believed to be the effect of the radiation on the ovaries. Radium placed inside of the uterus does have a local effect on the endometrium which reduces flowing but it undoubtedly also affects the ovaries.

The action of radium and X-ray is essentially the same. The result of radiation in the ovary is well established by the examination of animal and human ovaries after treatment. Most investigators (3, 4, 5, 7) agree on the important points. The action on the follicles of the ovary is what we are interested in as they contain the ova. The maturing graafian follicles are more susceptible to radiation than the primordial which is very important as will be seen. In a well developed follicle the changes consist in a degeneration and destruction of the ovum and the membrana granulosa, preventing the follicle from going on to maturity and leaving a small cyst (7). In less advanced follicles the ovum is destroyed but the single layer of granulosa cells is preserved (5). If the dose has not been large enough to cause a menopause, however, the primordial follicles remain intact, capable of maturing normally. Theoretically then it is possible to use such a dose of radiation that mature follicles may be destroyed and primordial follicles not damaged. This is what seems to occur clinically. Following treatment the patient may menstruate normally, have a scanty flow, or amenorrhœa for a few months depending on the size of the dose. If amenorrhœa occurs with this small dosage it is followed by a re-establishment of menstruation except in rare unusually susceptible cases. Ovulation and menstruation are believed to be definitely related to each other. Therefore theoretically if menstruation is present, fertility is possible. That this is clinically true will be shown later.

The other important consideration is the possiblity of the fertilization of a partially damaged ovum. Theoretically this might result in a deformed or poorly developed child or a so-called blighted ovum. There appears to be no data in regard to this point. No one has made a report of the examination of the products of conception in miscarriages from such cases. The percentage of miscarriages is greater in radiated than in normal mothers, as will be shown, but this was in a small series of cases. It requires further investigation. On the other hand no one has reported the birth of a deformed child and only a few underdeveloped ones are found.

The results of radiating fertilized eggs and the fetus *in utero* are quite different, however. Unterberger (8) has shown that the offspring from fertilized butterfly eggs which have been radiated produce adults only two-thirds as large as normal and the next generation is

even smaller. Experiments on cold-blooded animals have shown malformations and lack of development after radium or X-ray treatment of the eggs or fetus (1). There are a few similar observations on warm-blooded animals such as those made by Forsterling and Cohn, who found backward development in guinea pigs whose mothers were radiated during pregnancy (1). There are a few reports of similar cases in humans.

Reports of children born from mothers previously radiated for functional or fibroid bleeding are few and mostly incidental to other subjects. The largest group of cases that we have seen is reported by Werner (9). From November, 1911, to January, 1919, 990 cases of menorrhagia and 522 of fibromyomata were treated by radiation. He has been able to collect 24 pregnancies following the treatment in these cases. These resulted in 13 well developed, normal children, 1 premature, 9 abortions at from 2 to 5 months, and 1 hysterectomy for fibroid at 5 months. Two of the living children, three of the miscarriages, and the operated one followed amenorrhœa of several months' duration. The other mothers had oligomenorrhœa. Of the 9 abortions 3 were induced. Therefore there was 1 abortion to about every 2 normal births which is rather high as in Germany it is generally 1 to 5. All the living babies were normal and developed normally. It must be remembered that although the number of pregnancies seems small for such a large number of cases we have no data as regards the number who were still capable of bearing children. This series includes patients of all ages, married and unmarried, and relatively few radiated patients are in the child-bearing age.

Steiger (6) reports a pregnancy following X-ray treatment of a fibroid uterus reaching almost to the umbilicus in a woman 39 years of age after amenorrhœa of 4 months' duration. This resulted in a normal 9-pound baby, well and strong 1 year after birth. He cites a case of Pankow occurring after amenorrhœa for 18 months. Three years after birth the child was undernourished but this might have been due to war conditions. Zangermeister (6) reported a normal child following a 6 months' amenorrhœa. Schumann cited by Heiman (3) reports one. Heiman (3) had one in a patient 43 years old following radiation oligomenorrhœa and at 3 years the child is well and strong. Ferrari and Laffont (2) report one.

At the Free Hospital for Women reports have been obtained from 25 married women in the childbearing age treated by Dr. W. P. Graves with radium inside the uterus for uterine bleeding. Their average age was 34. Four of them report pregnancies after the treatment as follows:

31–249, age 24, had a miscarriage in March, 1919. She received 600 milligram hours of radium on August 5, 1919. Her menstruation began in November, 1919. She bore twins in March, 1921, both normally formed, one of which died 4 days later from unascertained causes. The other is living and well, 2½ years old.

28–367, age 21, had had no pregnancy previous to radiation. She received 200 milligram hours of radium on November 7, 1917. Her menstruation began 3 weeks after treatment, was regular for several months and then irregular, the longest interval being 5 months. She bore a normal baby on September 28, 1919, which is now well and strong 4 years later.

29–111, age 34, had borne eight children previous to the treatment. She received 400 milligram hours of radium on January 16, 1918. She had eclampsia resulting in a premature birth at 7½ months on January 30, 1922. The child lived two days.

34–162, age 24, had had no previous pregnancy. She received 200 milligram hours of radium on April 5, 1921 for membranous dysmenorrhœa. She became pregnant and miscarried at about 3 months on January 1, 1922.

There are doubtless other cases reported which the writer has not been able to find because they were reported incidentally under other subjects.

Radiation of the fetus during pregnancy gives quite different results as has been shown by animal experiments. It frequently causes underdevelopment. Werner (9) cites two cases in which one patient was X-rayed and the other treated with radium placed in the vagina during pregnancy because of a mistake in the diagnosis. The child born to the first was normal at birth but 6 pounds under weight at 6 years. The child from the second was small but perfectly formed at birth and about 1 year backward in physical development at 3½ years of age. Steiger (6) says

that this procedure may cause abortion during the early months of pregnancy but not in the later. Aschenheim (1) reports a case in which a mother was X-rayed during the third to sixth month of pregnancy on the diagnosis of fibromyoma. The child was a microcephalic imbecile with optic atrophy and cloudiness of the lens of the eye, the latter being characteristic of changes in the eye of experimental animals.

It is evident that a patient can be treated with radium or X-ray and bear normal children subsequently. We have no data on whether or not such treatment decreases the chance of becoming pregnant in women who wish children and it would be difficult to get reliable information. It is probably true that deformed or undeveloped children are not likely to follow such treatment. A damaged ovum is not capable of being fertilized or, if it is, it probably results in a blighted ovum which comes away by miscarriage. It does seem that the chance of a miscarriage is greater than in untreated women. It is important to examine the products resulting from such miscarriages to find out if the fetus is absent or deformed.

Care should be taken not to treat pregnant women, because it may cause a poorly developed or deformed child. More reports are needed to decide all these questions.

The writer is greatly indebted to Dr. W. P. Graves for permission to report his cases and to Mr. R. H. Smithwick for looking up the cases for him.

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CERVICAL SYMPATHECTOMY FOR THE RELIEF OF PAIN

Report of Two Cases Treated Surgically for Angina Pectoris

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CERVICAL sympathectomy has been done by various surgeons since 1896. Jonnesco (8) reports that since 1896 he has done this operation about two hundred times. The majority of his patients were suffering from epilepsy, a few from trigeminal neuralgia or migraine, and a good many from hyperthyroidism.

Franck (7) in 1899 suggested resection of the cervical sympathetic for relief of pain in angina pectoris but did not do the operation, nor did anyone follow his lead until Jonnesco in 1916 operated upon his first patient with angina pectoris, and in the few years following did similar operations on five other such patients. Tuffier (13) also reported one case operated upon with relief.

Other authors soon reported cases, although in the interval between October, 1920, when Jonnesco (9) reported his first one, and the present time the total of reported cases is few considering the rather glowing accounts of improvement in individual patients. V. Pleth (12) of Stockton, California, in 1922 reported 4 cases of resection of the left cervical sympathetic followed by complete relief of pain.

The most comprehensive report of patients so treated in this country was by W. B. Coffey and P. K. Brown (3), San Francisco, California, in February, 1923, when they told of 5 cases operated upon; and later in June, 1923, Brown (3) reported 1 more. Of these 6 cases 5 were greatly relieved. One died shortly after operation.

One other case is reported by Bacon (1), and still another well observed case by Bruening (4) in Berlin.

Just how this relief from pain is accomplished is a matter of a great deal of debate. Jonnesco, citing as his authority Mueller (11), believes that the only afferent cardio-aortic paths that can convey sensory stimuli are to be found in the cervical thoracic sympathetic chain; and it is thought that interruption of this path by removal prevents the overflow of a painful stimulus into the spinal cord and the sensory nerves that arise from the particular segments in the neighborhood. Other benefits of cervical sympathectomy are supposedly a generally lowered blood pressure, thus preventing overdistention of the aorta; removal of the possibility of death by vagal inhibition or medullary angiospasm; and a supposition of some authors (4) that there is apt to be a decrease in coronary vasoconstriction after sympathectomy and, therefore, improved blood flow. Bayliss (2) states that there is at present no definite proof of any such vasomotor nerve control of the coronary vessels, and, therefore, such ideas are purely speculative; but during operation Bruening has observed constriction of the vessels of the arm on the same side when the superior thoracic ganglion is pulled upon; and, conversely, after section of the sympathetic on the left, evidence of vasodilatation in the left arm and slight increase in local temperature. It seems tempting to reason by analogy that a similar effect might be produced in the coronary circulation.

Jonnesco advocates the resection of the entire cervical sympathetic chain below the level of the superior cervical ganglion, including the first thoracic ganglion; the operation to be done on the left side first and later followed by a similar one on the right, if complete relief is not obtained as a result of the first resection.

Coffey and Brown, also Bacon, report relief by much less extensive procedures, in some cases simply by section of the sympathetic between the superior and middle cervical ganglia with the cutting of the superior cardiac rami of the upper ganglion, or by removal solely of the superior ganglion.

More recently Eppinger and Hofer (6), taking the position that angina pectoris attacks

are secondary chiefly to aortic pathology and not to coronary artery disease, and that the main nerve through which afferent impulses pass from the aorta is the depressor nerve, have concluded that division of this structure should prevent the painful attacks. Hofer has carried out this idea in operating on 6 patients, dividing the structure bilaterally, where possible, and reports 4 cases completely relieved, 1 doubtful result, and 1 death from bronchopneumonia following tracheotomy. He ventures the opinion that Jonnesco and Bruening in their operations on the cervical sympathetic may have, without realizing it, sectioned these fibers. This is vigorously denied by Jonnesco (10) in a late communication. These two writers differ radically as to what constitutes the main afferent path carrying the sensory impulses arising in the heart or aorta during the anginal attack, but, paradoxically, both seem to be successful in preventing its arrival in the central nervous system by their different methods of procedure.

Jonnesco cites several valid objections to the operation on the depressor nerve fibers. The main drawback is encountered in the difficulty of identifying these fibers in the human. They are subject to considerable variation, being included in the vagus nerve and leaving it at a rather inconstant level, constituting an inconspicuous nerve filament hard to recognize. The risk of injury to the superior laryngeal nerve, from which these fibers often branch, with consequent necessity of tracheotomy is also a considerable objection.

At any rate, ease of approach, and certain identification of important structures, together with the constant favorable results in suitably chosen cases, seem to make the Jonnesco operation a simpler and more generally useful procedure.

The operation has usually been done under local anæsthesia alone, or combined in many cases with gas-oxygen. Coffey and Brown's one fatal case was the only one in which they were obliged to use ether on account of the struggles of the patient while under gas-oxygen.

The common after-results of resection of the cervical sympathetic are well known. The characteristic enophthalmos together with pupillary miosis usually develops promptly on the side of operation. Occasionally there is noted some transient conjunctivitis on that side.

As to the indications for operation, these are rather difficult to define sharply; but at least it may be stated that regardless of the etiology of the angina pectoris—whether or not the pathological basis is syphilis of the aorta, or arteriosclerosis of the aorta or coronary arteries—when the seizures are so severe or frequent that following an occupation is impossible, and life in general is intolerable, resection of the cervical sympathetic on one or both sides, especially if the superior thoracic ganglion is included, does offer a decided probability of considerable relief from pain and of return to gainful occupation.

Whether or not the life of such an individual can be prolonged, or the efficiency of the heart's contractions improved by such a procedure is another matter. Many believe that this is the case. P. K. Brown reports one patient whose electrocardiogram showed negative T waves which returned to iso-electric after operation. Jonnesco mentions increased ability to withstand exertion following convalescence from operation. But it must not be forgotten that angina pectoris is a symptom and not a disease and the prognosis of the cardiac condition should be carefully considered before the operation itself is advised.

As to ill effects on the heart from the operation, exclusive of immediate effects of the anæsthesia and manipulation, it seems clear that there is none. Jonnesco has never been able to discover any in 200 cases, and there is no deprivation of the mechanism of cardiac acceleration under increased work.

The sole contra-indication to operation seems to be existing cardiac failure. Recently two of Jonnesco's patients were suffering from some degree of failure at the time of operation and both died after the operation. He therefore advises against attempting the operation unless the cardiac condition is sufficiently good to enable the patient to reap some benefit from its result.

Some might feel that in general the seizures of angina pectoris are in a measure a protec-

tive mechanism that prevents the patient from continuing to exert himself past the point of safety and that it is unwise to take away this warning, if, theoretically, the absence of such warning might tend to shorten life. We can find no mention of any such tendency in the postoperative course of reported cases. However, it would, indeed, be well to observe these patients frequently after operation and they should be strictly enjoined against overexertion.

REPORT OF CASES

CASE 1. (25258.) J. H., tool and die maker, age 46, was admitted to the hospital first on January 23, 1923, complaining of hernia. He stated that he had a primary lesion on the genitalia at 22 years for which he never received any treatment, and that he has a son now aged 20 suffering from congenital syphilis with syphilitic keratitis. For 2 months previous to admission he had had attacks of severe agonizing precordial pain radiating down to the left arm as far as the wrist. The attacks were brought on chiefly by exertion, excitement, anger, getting out of bed in the morning, and on going out into the cold air after work. There was some dyspnœa at the time of the attacks of pain but at no other time. There was steady pain in the neighborhood of the left shoulder and difficulty in using the left arm. He entered the hospital requesting operation for bilateral inguinal hernia.

The past history was unimportant save for the history of luetic infection at the age of 22.

Examination. There was some pallor of face and cheeks, and evidences of poor nutrition. The pupils reacted a trifle sluggishly to light. The ears and nose were normal, tonsils rather large. There were several crowned teeth. A few lymph nodes were palpable at the angles of the jaws. The chest was normal in appearance, the lungs were clear. There was marked limitation of motion of the left arm at the shoulder and pain on passive motion, with marked diminution in the volume of the left radial pulse. Blood pressure: right arm—systolic 118 and diastolic 35; left arm—systolic 70, diastolic 40. Relative cardiac dullness: 11.5 centimeters to the left of the mid-line in the fifth interspace and 4 centimeters to the right in the fourth. Regular rhythm —70 per minute. There was a rough systolic murmur in the aortic area audible as high as the clavicles, and a prolonged diastolic murmur audible here and along the left border of the sternum. A blowing systolic murmur was also heard at the cardiac apex and in the axilla. There was no dyspnœa or cyanosis, no enlargement of the liver, and no œdema of the ankles. There was a right and left indirect inguinal hernia.

Urine examination. Normal findings. Wassermann: 4 plus with plain and cholesterinized antigens. Spinal fluid shows normal findings and negative Wassermann. Fluoroscopy of the chest shows slight cardiac hypertrophy and dilatation of the aortic arch but no aneurysmal formation. X-rays of the left shoulder show evidence of slight atrophic changes in the outer end of the acromion and clavicles.

Diagnosis. Syphilitic aortitis with aortic insufficiency and angina pectoris. Bilateral indirect inguinal hernia. Chronic synovitis of left shoulder.

Treatment. In view of the fact that the patient had had no antiluetic therapy at all, it was deemed advisable to postpone operation for hernia until after he had been given a suitable course of treatment. He was given 1/100 grains of nitroglycerine for the relief of pain and this did cut short his attacks. From March 13 to October 10 he was treated intensively with potassium iodide and given seven injections of neo-arsphenamine intravenously, as well as numerous intramuscular injections of mercurial salicylate. Nevertheless, the attacks of precordial pain gradually increased in frequency and intensity, especially at night, greatly interfering with his rest and preventing him from following his occupation. The patient expressed himself repeatedly as wishing he were dead and declaring, "Were it not that I am a family man, I would certainly shoot myself."

Operation. The operation of left cervical sympathectomy was done by one of us (R. D. McC.), November 13, 1923, under local anæsthesia supplemented by nitrous oxide and finally ether. Just before the operation the patient had a severe attack of precordial pain and was given nitroglycerine. It having been determined to do as little as possible, the middle cervical ganglion as well as the small connecting branches going to the superior cervical ganglion were removed with the sympathetic cord as high as the superior cervical ganglion. The patient's pulse decreased to 56 as the vagus nerve was lifted forward. At the end of operation when this was dropped back, the pulse became markedly accelerated.

Following operation, left enophthalmos and miosis of pupil were noted. The patient experienced no pain until 4 days after operation when he had one mild anginoid attack radiating as usual, not requiring nitroglycerine for relief. Electrocardiogram (Fig. 1) made 6 days after operation showed no marked abnormality. He was discharged from the hospital 6 days after operation feeling fairly well.

December 15, 1923. He states that he had a bad cold and fever after his return home; stayed in bed and had no pain; but for the past 2 weeks, after recovering from the cold, he now has his attacks about four times a night, and often in the day. The attacks are about half as severe as before operation and easier to relieve. One especially disagreeable symptom is priapism, which has been occurring six to eight times a night and preventing his sleep.

January 15, 1924. He still feels his life is quite intolerable on account of the frequency of his angi-

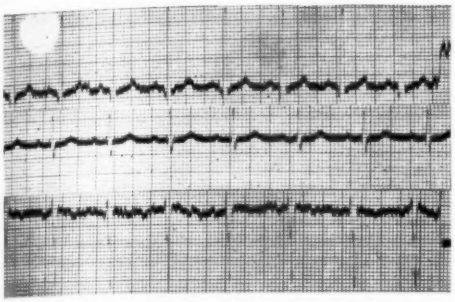

Fig. 1. Electrocardiogram, Case 1, 6 days after operation.

noid attacks. "Would shoot myself if I were not a married man."

At a second operation, January 18, 1924, a right cervical sympathectomy was done under novocain and gas-oxygen anæsthesia. The right middle and lower cervical sympathetic ganglia were resected.

Two days after operation he experienced two typical anginoid attacks.

March 9. The patient states that following the second operation priapism did not recur. For the first 2 weeks he had daily a good many rather mild anginoid attacks; but since this time he has had not more than two daily—one at bedtime, and, more often, one on getting up in the morning. These are mild and are easily relieved by nitroglycerine. He sleeps soundly through the nights now for the first time in a year and a half, and has been able to return to work. His fellow workmen suspect him of using alcohol to excess on account of his ruddy color and heavy lidded appearance.

He shows miosis of the pupils and bilateral enophthalmos, but no other disturbance has been noted following the second operation. He states that life is now much more worth while, and he is quite pleased with the result of the operation.

April 11. He is having very few attacks, often goes for days without any, and when they do occur they are slight. Complains today of some soreness at the lower end of the incision in the right side of the neck and of a little difficulty in raising the right arm above the head. Examination reveals that there is paralysis of the right trapezius and shoulder drop on that side. He is not sure whether this is a recent development or not. The cardiac findings are essentially unchanged since before operation. He again expresses himself as having been very much improved by his operation. The shoulder does not trouble him since he is now doing clerical work.

Case 2. (35955.) D. L., retired, age 69. Admitted to the hospital November 8, 1923, complaining of attacks of precordial pain. The attacks have been present for 10 or 12 years and consist of intense agonizing pain over the lower sternum, radiating principally to the right front of the chest and down

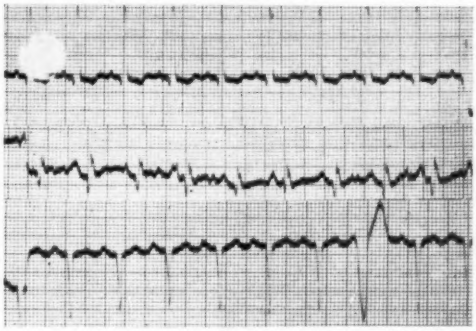

Fig. 2. Electrocardiogram, Case 2, November 8, 1923, 12 days before operation.

the right arm, to a lesser extent to the left of the mid-line, and rarely down the left arm. The attacks occur often during the day, initiated by exertion or excitement, but are especially frequent and severe at night, occurring eight or ten times, and preventing his rest. He has been taking nitroglycerine over a long period of time for relief of pain, but the relief is rather slow in coming and the frequency of the attacks is undiminished. He is dyspnœic on very slight effort but there has never been any œdema. He continually suffers the "tortures of the damned," and states that his life is not worth while this way.

The past history was unimportant.

Examination. The patient is an elderly man, with no dyspnœa or cyanosis. The pupils are equal, with normal reaction to light. Ears and nose are negative. There are a few crowned teeth. The chest is well formed, and the lungs clear. The heart is moderately enlarged. Cardiac dullness, 11.5 centimeters to the left in the fifth interspace and 3 centimeters to the right in the fourth interspace. Blood pressure, 135 systolic and 75 diastolic. There are

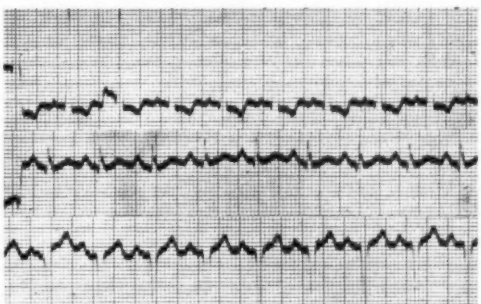

Fig. 3. Electrocardiogram, Case 2, November 27, 1923, 7 days after operation.

no murmurs. Fluoroscopy of the chest confirms the impression of moderate cardiac hypertrophy, and also shows the aortic arch to be somewhat tortuous with a prominent aortic knuckle and slightly dilated. The radial wall is considerably thickened. There is no œdema and no enlargement of the liver, but the patient becomes dyspnœic on slight effort and is observed to have frequent severe attacks of precordial pain, for which relief is finally afforded after the administration of nitroglycerine.

Urine examination shows normal findings, save for occasional hyaline casts. Phenolsulphonephthalein excretion, 57 per cent in 2 hours. Wassermann, negative. Non-protein nitrogen, 30 milligrams per 100 cubic centimeters of blood.

Electrocardiogram (Fig. 2), November 8, 1923, shows very pronounced left preponderance and inversion of T waves in lead 1, left ventricular extrasystole.

Diagnosis. Severe grade of chronic myocarditis and coronary sclerosis with angina pectoris. Prognosis poor. Operation was not advised but was offered as an alternative to the hitherto unsuccessful medical treatment as a measure of relief of pain.

Operation. Left cervical sympathectomy, November 20, 1923. The patient was prepared by preliminary administration of scopolamine and morphine, but in spite of this had a very severe anginoid attack on arriving in the operating room. One of us (R. D. McC.) resected the sympathetic cord below the superior cervical ganglion, including the middle and inferior ganglia. During the manipulation of the sympathetic there was noted cyanosis of the left side of the forehead and coolness of the left arm.

Following the operation the patient was entirely free from pain for 2 days. On the third and fifth days he had slight anginoid attacks for which nitroglycerine afforded relief. Electrocardiogram (Fig. 3) on November 27, gave identical findings with previous one, except that there were no extrasystoles.

Alternating pulse was noted in recording blood pressure. The systolic was 120 and the diastolic 70. The patient was discharged on November 30, and went to his home in Windsor, Ontario. Subsequent information is derived from a letter from the patient and conversation with his son.

Letter on January 24, 1924, states: "I am improving slowly. The soreness in my neck and left shoulder is becoming less. While I still have those pains in my chest they are not as severe as before the operation. They seem to settle principally in the right side under the right arm and breast. I am able to exert myself but very little."

March 1, 1924: The son relates that ever since the operation the father has had hardly any pain; but recently he has developed shortness of breath and severe cough. It is presumed that he is having some degree of myocardial failure. He expresses himself on behalf of the family as being more than satisfied with his father's course following operation, and believes that his life in the interval was made much more comfortable than before the operation. He is being kept in bed and is under the care of his family physician.

April 1, 1924, the family physician reports by telephone that the patient is in a grave condition of myocardial insufficiency with general anasarca.

COMMENT

The occurrence of priapism in Case 1 during the interval between the first and second operations is unusual, and we are not able to find any other reference to such occurrence in the literature. It may have possibly been due to the production of irritative stimuli in some way in the sympathetic system from lack of balance on the two sides, which was later equalized after the other side was resected. At any rate it was a very marked feature during the interval between operations and disappeared promptly following the second operation.

We do not believe that the shoulder drop in this case is due to section of the spinal accessory nerve on this side, since particular care was taken to avoid dividing this structure at operation. Undoubtedly, its function has been terminated for the time being through outstretching, but we are in hopes that later on this paralysis will clear up.

It is apparent from these two cases that, while we are able to report in each a great decrease in the frequency of the seizures and a marked reduction in their intensity following these operative procedures, in neither did we obtain complete freedom from the painful attacks. In Case 1, patient with syphilitic aortitis, this may have been because we did not remove the first thoracic ganglion on either side, as has been urged by Jonnesco. This falls in with the failure which attended that author when in one instance, operating away from his usual surroundings without certain special instruments, he resected the cervical sympathetic without the stellate ganglion. In Case 2, patient with marked arteriosclerosis and pain which was mainly radiated to the right front of the chest and right arm, it would, no doubt, have been better to have resected the right sympathetic chain instead of the left, since after left sympathectomy the sinistral radiation of pain to the right persisted in some degree. This case is of partic-

ular interest when compared with the one which was reported by Philip King Brown with dextral radiation of pain, in whom complete relief followed the resection of the right superior cervical ganglion.

CONCLUSIONS

While in many cases resection of the cervical sympathetic in angina pectoris, unilateral or bilateral, may greatly lessen the number and minimize the intensity of the painful attacks, it must not be counted on to secure complete relief from pain, unless the first thoracic ganglion is included in the resection.

The resection should be done first on the side which has shown the greatest or most severe radiation of pain, and followed later by a similar operation on the other side, if complete relief is not obtained after the first one.

As has already been pointed out by Jonnesco, more favorable results may be expected in those individuals in whom the painful attacks dominate the picture, while the cardiac compensation is good, than in the patients who give evidence of grave heart muscle damage or are already in a state of cardiac failure.

The main indications for operation are:

1. Frequent and severe attacks necessitating the giving up of occupation, and not yielding satisfactorily to medical measures.

2. A feeling on the part of the patient that the painful attacks provide an intolerable situation.

The main contra-indication for operation is existing or impending myocardial insufficiency.

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BENIGN TUMORS OF THE PLACENTA

A Review of the Literature and Report of a Chorio-Angioma[1]

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A CASE of benign tumor of the placenta was first reported by John Clark in the Philosophical Transactions of the Royal Society of London in 1798. Since that time there has been reported an average of less than one case a year. The period from 1798 to 1913 has been well summarized by Yamato (1913). He collected 116 cases and added one of his own. His conclusions are most valuable and will be referred to later. During this early period, and included in Yamato's series, notable reports were made by Virchow (1863), Goodhart (1882), Galabin (1882–1885), Albert (1898), Dienst (1902–1904–1906), Ries (1904, the first case reported in American literature), and Pitha (1907). In addition to the cases reported by Yamato, in my review of the literature, I found two additional cases reported by Albert (1898), one by Alin (1891), one by Bohnke (1903), one by Dion (1897), and one by Lowenberg (1898).

During the period 1912 to 1924, 30 cases were reported, only 6 of these being cited in the American literature. The bibliography, at the conclusion of this article, gives a complete record to date.

The general term "angioma of the placenta," has been insufficient according to many writers, as evidenced by the numerous terms used for this type of tumor, fifteen in all, namely: angioma, myxofibroma, subchorial placental cysts, fibroma, simple organized coagula, cellular hyperplasia, myxoma fibrosum telangiectodes, placental polypi, connective-tissue hyperplasia, hyperplasia angiomatosa, hyperplasia of the villi of the chorion, false knots formed by the umbilical cord within the placenta, varicose veins in placenta, placentitis fibrosa, polypous hæmatoma. The writer is inclined to favor the term *chorio-angioma fibrosum*, which term was accepted by Pitha. This term is self-explanatory and differentiates this type of tumor from those arising from the epithelium, which are malignant.

Most writers agree as to the origin of these tumors, namely, the chorionic villus. The proliferation arises from the capillaries which cannot be designated merely as villous capillaries, and from vessels of the allantois.

The etiology of benign placental tumors is a much debated question. Yamato has mentioned the following views: (1) the inflammation theory; (2) developmental anomaly, (3) hyperplasia theory; (4) bleeding theory; (5) parasitic origin; and (6) congestion, (a) on the part of the fetus, (b) on the part of the mother, and (c) modifications in the blood vessels themselves.

Dienst agrees with the congestion theory. He points out that his first case was that of a woman suffering from arteriosclerosis and at a period just before the climacteric, and the child was born with symptoms pointing to an impediment in the outflow of venous blood. These symptoms pointed with the greatest probability to primary maternal and secondary fetal circulatory disturbances. Such symptoms were still clearer in his second case in which there were signs of incompensation of the heart in connection with renal troubles resulting in interrupted pregnancy. Thus, he maintains, the foundation for the development of the tumor is laid by a congestion in the maternal organism toward the end of the third week of the placental period.

Yamato's argument is as follows: Granted that in the parturient there is a general congestion, if this alone can lead to angioma, we would expect to find not only placental angioma, but angioma of the skin, liver, spleen, kidney, etc. As a matter of fact, in many cases of placental angioma there are no symptoms of congestion anywhere. Since an angioma forms in the placenta only, the remote cause of the tumor must certainly lie in the villous tissue.

[1] Read before the Chicago Gynecological Society, March 21, 1924. (For discussion, see p. 251.)

With this point in mind, we may infer that the complications, such as congestion, syphilis, etc., are at the most only proximal causes.

Yamato accepts with modifications the Cohnheim and Ribbert theory of the etiology of tumors. At the beginning of the embryonic period the mesoderm (which forms the allantois capillaries that supply the villi and form their connective-tissue membrane) abnormally persists at the location at which the formation of the villi takes place.

Albert states that when the allantois in association with the chorion enters into the formation of the decidua, a part of it remains behind to contribute to the formation of the umbilical cord. From this latter part, a blood vessel branches off, finds no normal association with other parts, and thus develops independently into a tumor.

Pitha, who reported a large number of cases, holds to the congestion theory, and believes that the congestion gives the impulse to a proliferation of the embryonic tissue, which in turn can cause a telangiectatic malformation of the chorionic villi. The stasis of the blood can in turn be caused by a large variety of causes leading to narrowing of the lumen, as for instance, kinking at the insertion of the umbilical cord, varicose dilatation of the veins, spiral arteries, looping or twisting of the arteries, etc.

The writer agrees only in part with the theory of congestion on the part of the mother, because in those cases reported in which the age of a patient is mentioned, the majority were under the age of 30, therefore, their cases would not be complicated commonly by arteriosclerosis, or œdema accompanying a nephritis, or an uncompensated heart condition. These would be, more or less, exceptions. If this type of tumor is to be classed as a real tumor, I agree with the theory of Cohnheim, in that a congenital basis is necessary for the development of any tumor, and with Kuster as regards a placental angioma being a congenital tumor derived from the blood vessels of the villi.

These tumors are generally found in the midst of the placental tissue, in the chorionic membrane (Ries), protruding as a rule on the fetal surface of the placenta. Lining formed by Langhan's cells with little syncytium. The majority are encapsulated. Kermauner summarized what is known concerning these placental tumors, describing them as tumors consisting of sharply defined nodules of lobulated structure connected with the chorionic epithelium by one or more pedicles, and with the rest of the placental tissue in various ways by secondary fibrinous adhesions, lying in the intervillous space and touching neither the chorionic epithelium nor the decidua directly. Usually they are solitary, but multiple ones have been observed.

Yamato, in his list of 28 cases in which the ages were given, found that 25 per cent were between 17 and 20 years, 25 per cent were between 26 and 30 years, and 17.85 per cent between 21 and 25 years. The majority were under 30 years, and generally primipara. He also stated, that in most of the cases summarized, the patient's health was good previous to and during the pregnancy. Of the few complications, hydramnion was the most common. In his list of 116 cases, maternal lues was not confirmed in any instance. He found only two writers who mentioned bleeding, one case by Labhardt being worthy of mention.

The patient, 42 years old, while on a railroad journey, noticed sudden pains and bleeding. A premature birth occurred. In the placenta was a tumor, which had perforated in the middle of the maternal surface. In the tumor was a hæmatoma, from which, as a result of the contusion, there was an infusion of blood. The case is instructive, and offers suggestions for further investigations.

Chorio-angiomata of the placenta vary in size from that of a walnut, to the size of a kidney, and a few tumors have been reported that have covered two-thirds of the placental area. They play very little part in the pathology of labor. A number of cases are cited that were pathological and in which the tumor was discovered. I found only one case in which it acted as a mechanical obstruction to the advance of labor. The case was reported by R. D. Margeson, of Boston, 1919.

The case is that of a patient who had irregular sharp pains across the lower part of the abdomen and back at irregular periods during pregnancy. She had no toxic symptoms during her entire preg-

nancy. The patient went into labor at term, and after 12 hours of regular pain, which had gradually increased in severity, examination showed little dilatation of the cervix, with no engagement of the head. A classical cæsarean section was performed, and a normal 8½ pound baby was delivered. The placenta, which was attached to the posterior wall of the uterus, was freed with difficulty. Attached to the placenta by a pedicle 6 centimeters long, was a tumor 10 by 6 by 3 centimeters. When found, the tumor was overhanging the left pelvic brim, and this, in all probability, was the obstacle which prevented the engagement of the head. The pedicle was surrounded by amniotic membrane and had no uterine attachment, in this way differing from the succenturiate. The principal content of the pedicle was fibrous tissue.

The microscopic findings show great conformity (Kermauner). The chief features noted are the embryonal connective tissue and the cavernous capillary proliferation. According to which of these two features predominates, they are spoken of as fibroma or myxoma and as angioma, but, although these terms may still be used, it must be recognized that the tumors in spite of the varying outward appearance, are of absolutely the same character. The chorionic epithelium is involved only secondarily in the proliferation and in an entirely subordinate manner. In the tumor formation, in contrast to hydatid mole, it has no share.

Before reporting my own case with its detailed microscopical description, I have thought it of interest to repeat here parts of the original report of the first placental tumor by John Clark in 1798.

"The tumour which gave occasion to this paper is, however, one instance to prove that these vessels are capable, like those in other parts, of forming solid organized matter, and that very considerable deviations from the ordinary structure of the placenta may exist and be perfectly compatible with the life and health of the fœtus.

"Previously to the birth of a healthy child, an amazing quantity of liquor amnii was evacuated, which was by accident received in a vessel, and, being afterward measured was found to amount to two gallons, Winchester measure. When the placenta came away, a hard, solid body was found in its substance. It was preserved by Mr. Mainwaring, under whose care the case occurred, and was by him, obligingly presented to me. Fine injection was thrown into the arteries and veins of the funis umbilicalis: when they were filled, they appeared to be enlarged thrice beyond their natural size.

"The placenta, thus prepared was subjected to examination. Its anterior surface was found to be covered with the amnion, behind which lay the chorion, as usual. Some branches, both of the arteries and veins coming from the funis ramified in the common manner, forming the fœtal portion of the placenta. Others of very large size, not less than a swan's quill, were sent to the tumor: which was situated behind the chorion and lay imbedded in the fœtal portion of the placenta. The general form of the tumour was oval, about four inches and a half long, and three inches broad. The thickness of it was three inches. It weighed upwards of three ounces. Its shape resembled that of a human kidney: one edge being nearly uniformly convex, whilst the other, where the vessels approached it was a little hollowed. If the mere existence of such a tumour is not to be considered as a disease, there was no appearance of any morbid tendency in any part of it. The whole structure seemed to consist of a regularly organized matter throughout supplied with vessels, exclusively belonging to itself and not passing to it from the surrounding parts, as is generally the case in diseased masses.

"They who are inclined to consider every new appearance in the structure of parts as disease may be disposed to include this under that appellation. But disease consists of such an alteration in the structure, or functions, of a part, as occasions the natural operations of it to be imperfectly performed, or entirely arrested. This tumour appears to have produced no such affect: all the common known functions of the placenta were performed, notwithstanding the existence of this substance. I am disposed, therefore, to consider this fleshy substance as a solitary instance of a formative property in the vessels of the placenta: which they have not been hitherto known generally to possess.

"There was a remarkable circumstance attending this case, which ought not to be lost sight of, viz., the extraordinary quantity of liquor amnii, which had been contained in the ovum. What connection there was between this and the tumour, cannot be absolutely explained from a single instance, as there did not seem to be any direct communication between the tumour and the cavity of the amnion. The whole of it lay, as has been before related, behind the chorion: so that, between it and the cavity of the ovum, there were two membranes interposed. In its organization, it had all of the appearance of a glandular part, and was extremely vascular, but, upon a very attentive examination of it, no duct could be found leading from it into the cavity of the ovum.

"Yet, although it may appear difficult to prove that the quantity of liquor amnii depended upon this substance, still, as it so considerably exceeded that which is found in common, or has ever been described, it is reasonably to be believed that it did so.

"The manner, however, by which the secreted fluid was conveyed from the tumour into the gen-

eral cavity of the ovum, must still remain unaccounted for."

A report of my case follows:

The patient was a primipara, age 32 years. Her pregnancy was normal, the urine was negative and the blood pressure averaged 118 millimeters. She went into labor spontaneously at full term. The labor was short, covering 4½ hours. Delivery was accomplished with low forceps after the head had been on the perineum 30 minutes. The placenta was expelled spontaneously after 15 minutes by the Duncan method. The baby weighed 6 pounds and 12½ ounces and was in good condition. The convalescence of the patient was uneventful excepting for a low grade temperature on the fourth and fifth day postpartum. The report on the placenta by Dr. J. L. Williams is as follows:

Pathological report of placenta, December 19, 1922. The specimen is a placenta 20 by 18 by 3 centimeters with fetal membranes apparently complete, and 55 centimeters of umbilical cord attached. The fetal membranes and umbilical cord are stained brown. Opposite the attachment of the umbilical cord and in the placental substance, there is a dark red, firm mass of uniform tissue, 5 by 4.5 by 2.5 centimeters and weighing 70 grams. This mass is encapsulated and can be shelled out of its capsule. Running into this mass is a branch of one of the placental vessels and the lumen here is practically obliterated. Careful and repeated sectioning of the placenta fails to reveal any other tissue similar to th mass previously described. The placenta, fetal membranes and umbilical cord together weigh 657 grams.

Microscopic examination. Sections of this tumor mass reveal multiple blood-vessel spaces of irregular size, filled with blood and lined with endothelium. There is a small fibrous capsule very indefinite in outline, surrounding the body of the tumor. Most of the blood vessels of this tumor have thin walls but occasionally there are groups of larger thick walled vessels resembling arteries. The large artery supplying this tumor is partially thrombosed.

Diagnosis. Hæmangioma of the placenta.

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SOME PROBLEMS OF DRAINAGE

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MY very simple remarks concern what seems to many a very simple business. It is easy enough to say, "When infection is present or is threatened, drain the wound!" But the war made some of us think about the matter a little more than we had thought about it before, because it was found that in war wounds, drains might even do harm rather than good.

It is a good thing always to keep in mind the truth of the statement that the success of large problems depends on proper appreciation and application of often apparently insignificant details.

In directing your attention to the question of drainage I should like to point out that I have for a very long time thought that we surgeons do not give nearly enough credit to a patient's natural recuperative powers, and that we do not have enough faith in these in the ordinary run of cases which come under our care. Indeed, it was many years before the war that I began to wonder whether, in the matter of drainage, we were not sometimes interfering with natural processes of healing actually in a deleterious and unnecessary way. It must be nearly 20 years ago that, as a result of such cogitation, I desisted from employing drainage of the abdominal cavity in cases of what might be called simple gangrenous peritonitis, i.e., cases unaccompanied by spreading peritonitis; and now I drain the peritoneal cavity only in rare cases, it matters not whether localized abscess or spreading peritonitis is present.

I think that the use of drains at the present time is still too indiscriminate. The question, "Why should I drain in this case?" is too seldom asked. Few seem to get away from a routine which was instituted at a period when pus was a source of dread, instead of a thing to be thankful for, to be regarded as

evidence that the patient's resisting powers had put up a good fight and that the surgeon was lucky to have a patient left on whom he could operate *ante mortem*. The problem is a difficult one in many cases, but I believe that in the majority of localized inflammations we may look upon pus really as a "laudable" thing. We should probably all be dead if pus had not formed within us at one time or another in our history. Further, if we provide free exit for the cause of the suppuration, that is, if we can accomplish thorough exposure and evacuation of all the deleterious material in an abscess, we shall get quicker and better results if we do not employ drainage by tube in the way it is so frequently applied. In some parts the natural powers of repair are so strong that we can often dispense with drainage altogether. In these parts, especially in the peritoneal and pleural cavities and in joints, the employment of drains actually may lead to very troublesome sequelæ and complications.

What happens when an acute local infection occurs, one which is amenable to surgical treatment? When I think of the offensive and defensive processes which come into action I feel that they can be likened in most ways to those which occur in a war between nations. There is the initial cause, whether it be an apparently insignificant disturbance or a gross insult, which may become so magnified that it may ultimately call into play all the available resources of the nation or of the individual in order to cope with the attack. Where the original boundary line has been forced, neighboring fighting phagocytes are hurried into the breach, local tissue cells are enlisted to repel the invader, and a first line of defense filled with reinforcements is rapidly thrown up to take the place of the dead and dying which lie inert in the abscess cavity where the attack began. Messages are dispatched from the scene of action to headquarters by nerve impulses; and by various other methods of signaling danger, all the tissues of the body are called into activity. Poisonous influences may filter through—enemy agencies may develop—to such an extent that this reaction may be too feeble or too long delayed to save the situation, and the patient is overcome or permanently maimed. But in the prospect of success the resistant forces accumulate locally and are well supplied with potent counteractives and good food. Thus encouraged they overcome the enemy and cast him out. After a period of soreness, of disability, of impaired function, convalescence sets in and, according to the degree of the local devastation and of the drain on general resources, conditions may or may not be speedily restored to pre-war levels.

In how far does the use of the old fashioned drainage tube help the local condition? In different situations in which I have seen it used it has frequently caused serious complications, chiefly due to pressure, such as sloughing of skin, for example of the scalp, sloughing of vessels, sloughing of bowel, and so forth, so that healing has been greatly retarded. To say that in the situations mentioned tubes should not be used or used only with the greatest care so as to avoid these complications, is no criticism. These things have occurred and are still occurring and therein lies one reason for my choice of subject.

Along with the use of drainage tubes goes usually, hand-in-hand, the fault of making too small incisions. To revert to my allegory, the wider the line of retreat for an enemy the quicker will he quit. I do not advise senselessly large incisions, but they should extend where possible from end to end of the abscess. I would point out that in most situations it is usually sufficient to open a way freely by which the invader can be cast out forthwith and unless there has been great local destruction nature will do that successfully without much aid. If local destruction has been severe, as in the case, for example, of a carbuncle, the surgeon can prove a valuable ally by encouraging the separation of sloughs in various ways. Even if the general resisting powers have been greatly enfeebled, the free riddance from the field of the main mass of the enemy will enable the defender to recuperate quickly and to clear out the remnants, which may be lurking in odd corners, all the quicker if wise help be given by his ally in supplying what he lacks. The combatant

who has borne the burden and heat of the fight is usually capable of making a final effort and should get the credit and honor of putting in the finishing blows. If he does, things will usually settle down better afterward. The well meaning but often too brusque methods of a fresh ally may do damage to friend and foe alike and are resented afterward.

If the tissues have had enough vitality to form an abscess or even, as is manifest so often, for example, in the peritoneal cavity, if they have enough vitality to create a decided reaction in the presence of spreading infection, I maintain that nature will bring about cure more rapidly without officious help from us, provided we facilitate, or better still actually bring about, the free removal of deleterious material, including of course, the cause of the suppuration.

During the formation of an abscess the tissues elsewhere are busied in production of antibodies. When the tension inside the abscess cavity is relieved, fluid laden with these antibodies exudes into the cavity. At the same time local resistance is raised because the local circulation in the previously compressed tissues of the abscess wall improves. If the incision is large enough to provide free exit of noxious material hitherto confined in the abscess, and if there are no pockets in the cavity wherein stagnation may occur, the abscess will heal rapidly without further attention if the lips of the incision are prevented from uniting prematurely. If they do adhere exudate will accumulate in the depth. When it stagnates it is apt to lose its antitoxic property in contact with organisms and then it forms good pabulum for their growth. Usually however, such incisions gape. Dressings should be so built up around the incision that direct pressure over the gaping cavity is avoided, because such pressure will itself lead to retention. In certain cases the superficial insertion of a small strip of rubber dam is necessary. Klapp's suction glasses are sometimes very helpful in removing thick pus and promoting the flow of curative lymph. The evil results which may attend the expression of pus through a small opening by forcibly squeezing the tissues surrounding an abscess are so well known that the procedure has only to be mentioned to be condemned.

If, as I have already said, stagnation of the exuding plasma or lymph occurs, the antitoxic substances in it are used up in neutralizing organisms and their poisons which are almost certainly present in the abscess wall for some time after the cavity is opened. The inert fluid then forms an excellent pabulum for the resuscitation and growth of any remaining organisms, with the result that inflammation persists or recrudesces, possibly in a modified degree, and may spread. Therefore in some deep abscesses, especially in muscular parts, the use of artificial drainage, even by tubes, may be compulsory. In ordinary cases however the comparatively unyielding drainage tube really defeats its own purpose. It provides recesses in which stagnation occurs, it prevents active phagocytes getting at organisms which thrive in these recesses, it exerts deleterious pressure on tissues which are already in a precarious state and, as previously mentioned, may even cause sloughing thereof. In the treatment of war wounds Sir Almroth Wright introduced the use of hypertonic salt solution to act as a lymphagogue, and to stimulate the flow of antitoxic plasma to the inflamed part. Where there is excessive swelling and œdema around an abscess, indicating that the invading organisms are probably being fought deep in the abscess wall, I believe that there is no better method of reducing such inflammation and paving the way for rapid cure than by using what was known during the war as the "salt pack," i.e., by carefully filling the abscess cavity in every part with good absorbent gauze in the folds of which are evenly distributed tablets of salt. These are slowly dissolved in the exuding plasma and keep up, to a usually requisite extent, and for sufficient time, the supply of hypertonic saline solution. The gauze conducts the exudation to the surface where it is absorbed by superficial dressings and thus maintains the flow of lymph in an outward direction.

Many years ago I used similar treatment in cases of extensive peri-articular abscesses, with great satisfaction to both patient and surgeon. The abscess cavities were laid open

from end to end and after clearing away pus and sloughing material, they were carefully and equally packed with gauze. Antiseptic dressings were bound over this packing. After 3 to 6 days the gauze pack was found to be so slack that it almost fell out of the wound. Any loose sloughs were removed. The wound was then sutured, firm supporting dressings and splints were applied, and healing took place by what has come to be known as "delayed primary union." This treatment had its corollary in the treatment of war wounds by "delayed primary suture." That is, in cases of wounds in which it was doubtful whether excision had been successful in getting rid of infection, the wounds were packed or treated by Carrel's method and then if clean and free from inflammation after several days, were stitched up.

In a few cases of abscess, for example in the calf of the leg, I have adopted Willems' treatment with satisfactory result. That is, after free incision I have encouraged the patient to use the limb voluntarily, so that the pressure of the actively contracting muscle squeezes out pus from the depth and prevents stagnation. As you know, Willems of Belgium introduced this treatment during the war for cases of suppurating arthritis.

I may be permitted to run over, in some detail, the actual treatment which I now carry out in certain other suppurating conditions. Let us consider first and as a type of intra-abdominal suppuration, that very common disorder, acute appendicitis and its immediate sequelæ, abscess and spreading peritonitis. For the sake of brevity, I propose to deal only with the intra-abdominal condition. In such cases I make, practically always, a right paracentral incision, five or six inches or even more in length, a good inch distant from the mid-line, and I displace the whole of the rectus muscle outward. The posterior sheath of the rectus and the peritoneum are opened in the same line and extent as the skin incision. Through such an incision I can *see* what I do. I do not care to grope blindly inside the abdomen in such cases. Under careful retraction of the abdominal wall I find out what the conditions inside are. If there is merely an inflamed or gangrenous appendix without surrounding pus or spreading peritonitis, it is removed in the ordinary way and the abdomen is closed forthwith.

Let us suppose an abscess surrounds the appendix. I pack dry gauze, prepared in long broad strips, several layers thick, around the area so as to protect the uninfected general peritoneal cavity. The parietal peritoneum is pulled up by forcipes fixed around its cut margin, so that it helps to protect the raw surface of the abdominal wound from contamination. I then open the abscess cavity freely and dispose of the foul pus within it by suction and careful swabbing. The walls of the abscess are carefully wiped dry and temporarily packed with gauze. The appendix is freed from adhesions and removed in the ordinary way. The gauze is removed from the abscess cavity. It is usually by this time more or less moist with exudation. When I see this I feel sure that the patient will not succumb to his intra-abdominal condition. He may die from pneumonia, embolism, or other non-abdominal complications. If the gauze smells, the cavity is packed again for a few minutes. The pack is again removed, the surrounding parts are meticulously cleansed, possibly with moistened swabs, and if there is no hæmorrhage the peritoneal cavity is closed completely.

If spreading peritonitis is present the procedure is similar. It may be necessary to enlarge the incision in order to obtain free access and supervision. In these cases foul pus is usually found in the pelvis or along the right flank. If a large amount of fluid is present, it should be sucked out, failing which it should be absorbed at once by strips of gauze placed loosely in the pelvis or flanks. The bowel covered by gauze in the meantime should be retracted, preferably by the hand. When excess of stinking pus has been removed thus, the foully infected parts should be gently cleansed by swabbing with pads of gauze. Dry gauze strips are then packed into these infected areas. The appendix is freed and removed. The same procedure of repacking with gauze, as already described, is carried out, until the exudate moistening the gauze is found to be free from foul odor or very nearly so. Any large excess of *non*-smelling

pus is soaked up gently. Adherent flakes of lymph are not interfered with. Loose flakes are removed. The peritoneum is then completely closed. I usually place a rubber dam drain at each end of the wound; reaching to the preperitoneal tissue, in case the newly cut tissues have been infected.

When these procedures are carefully carried out, it is extraordinary how well the peritoneum deals with such infection as must of course be left inside the abdomen. I have never regretted not draining in such cases. Absorption occurs so rapidly in the peritoneal cavity that postoperative accumulation of plasma is a very rare event, provided no source of irritation remains. Since the war I have almost invariably regretted the use of intraperitoneal drains. I and my assistant have treated several hundred cases of acute appendicitis in my wards in Aberdeen since the war. We have felt compelled to resort to the drains in about 1 in 14 cases. The mortality in the drained cases was 9 per cent, in the undrained cases 5 per cent. The two conditions which make me feel I should use drains are (1) persistent oozing of blood from the surface of an abscess cavity and a condition of the patient necessitating rapid operation; and (2) a shaggy irregular lining covering the surface of the abscess.

I have repeatedly left small areas covered by gangrenous looking membrane when I have judged that the "discoloration" affected practically only the peritoneum. These cases recovered without complication.

During the after-treatment of the cases I drained I have had much anxiety. Prolonged stinking suppuration sometimes with secondary abscess formation elsewhere, fæcal fistula, septic pneumonia, etc., have complicated convalescence. I believe that non-drainage of the peritoneum prevents such complications to a large extent. Suppuration in the abdominal wall alone is usually of short duration. I believe further that intestinal trouble in the shape of partial or complete obstruction is much reduced in frequency. The irritation caused by a tube or other drain inside the abdomen tends to the formation of dense adhesions which may subsequently lead to serious trouble. If the results obtained without the use of intra-abdominal drains are as good as or better than those obtained with the use of drains, as I assert from experience that they are, why use drains?

Intra-abdominal drains do not drain the abdominal cavity except the small part which they themselves are irritating. The rest of the cavity is quickly shut off by the formation of adhesions. I have often observed this gluing together of contacting peritoneal surfaces even before operation was finished.

Since a drain provides direct communication from the surface with tissues in the depth, it is obvious that infection may gain access from the exterior along this track. Therefore, when a drain is used for any length of time it is more than advisable to use antiseptic dressings rather than inert plain gauze or wool. I should think that all of us have seen the following phenomena when drains have been left in an appendicular abscess for longer than a day or two. For the first 2 days the discharge is "sweet" and fairly clear. It then becomes more and more purulent, and smells as did the foul pus in the abscess cavity. In 4 or 5 days the pus has become brownish, like fæculent material, making one suspect that a fæcal fistula has formed. Usually by the end of 8 to 10 or 12 days the discharge is free from odor and rapidly becomes seropurulent, when the drain may be withdrawn. This course of events is, in my opinion, entirely due to the presence of the drain which stimulates a recrudescence of the activity of the micro-organisms which were the cause of the primary inflammation. I have already explained why this happens.

The experience of surgeons who did much abdominal surgery at the front during the war was such that they ceased to use drains. Their results in saving life and preventing complications were improved when they did so.

Remarks similar to the foregoing can be applied in cases of peritonitis from other causes, such as perforated ulcer or pneumococcal infection.

Briefly stated the plan I adopt in all such conditions is: to deal thoroughly with the primary cause of the trouble, remove carefully secondary deleterious matter which may

have formed in, or found its way into, the abdominal cavity; and close the peritoneum without drainage.

It was very interesting to note that during the war specialists in cranial and cerebral surgery went through a very similar experience. At the beginning of the war small credit was given to the powers of the brain in recovering from injury in the presence of sepsis. Some wonderful methods of "draining" wounds of this delicate structure were used. For example, I have seen tubes of perforated metal, half an inch or even more, in diameter, inserted deep into the brain along the track of the wounds in order to try to prevent or eradicate infection and also to do away with cerebral œdema which was thought almost inevitable in such cases. This really proved a very certain way of promoting the development of these evils which were meant to be avoided. More rational treatment prevailed before the end of the war and followed the lines which I discussed in connection with peritonitis. The primary cause of the trouble was dealt with, the missile, if it were still present, was removed if possible, secondary deleterious matter in the shape of fragments of bone, pulped brain and blood clot were removed by various methods and a drain was inserted "down to but not into" the wounded brain. Of course, as a preliminary the wounds of the scalp, bone, and dura were excised. The results of this treatment showed wonderful improvement on that which involved the use in the brain of crude artificial so-called aids in the shape of drains and irritating antiseptics. If the patient survived in spite of these "aids" he did so with a large amount of scar tissue in his brain and scar tissue there is a thing to be avoided.

It is recognized by most surgeons who have studied the matter that it is wellnigh impossible to drain such a complicated joint as the knee by ordinary methods. The ultimate results of treatment of wounds of the knee at the beginning of the war were appalling. At a meeting of French and British Surgeons in February, 1915, each speaker told practically the same dreadful story. Very few successes were recorded. Death or amputation (often followed by death) was the usual sequel of the various treatments employed. Later on, improvement followed excision of the wounded parts, both of soft tissue and bone, removal of the foreign body and other deleterious matter, and drainage "down to but not into" the affected synovial cavity. Then Willems, the Belgian surgeon, came into the field with the startling and novel suggestion that the only way to get rid of pus inside a joint was to make the patient pump it out by his own efforts. He discarded drains in the wounds altogether. Passive movement was no good, it was probably harmful. During voluntary movements the muscles, tendons, and aponeurosis round the joint effectually obliterate potential cavities by their pressure so that there is no room for any extraneous material. If there is free exit for pus it is squeezed out. Furthermore, these movements stimulate the circulation of the joint so that the flow of autogenous antitoxic serum through it is increased. Stagnation is not allowed.

I saw many of Willems' cases and the results were certainly impressive. I have since then employed this method of treatment with success in civil practice. It is so much opposed to that to which we have been educated that many difficulties present themselves. Its novelty and our innate conservatism tend to make us postpone its application too long. It should be applied at once when we are certain that such procedures as aspiration or washing out the joint are insufficient. The more acute the infection the earlier should the treatment be carried out. In the case of the knee, lateral incisions are made between the patella and edge of the condyle, about 2 inches in length, freely opening the joint. The patient must be encouraged in every way to make voluntary movements immediately on recovery from the anæsthetic and to repeat them frequently during the days following. He should be made to walk as soon as possible. Nurses and indeed all concerned must create such an atmosphere that the patient will put forth every effort. After the first couple of days the pain caused by movement gradually lessens. A loose antiseptic dressing to soak up discharge and to prevent access of sepsis from without is fixed over the wounds. It must not interfere with movement.

This method of treatment obviates the use of extension apparatus. The repeatedly altered position of the joint prevents undue pressure falling on circumscribed opposing parts of the softened articular cartilage continuously so that erosion of cartilage is avoided.

The last region to which I shall refer is the thorax. During 1915 and 1916 I acted as consultant in an area of France which comprised from 20,000 to 25,000 base hospital beds. During a period of 15 months I saw not more than ten really serious wounds of the chest. We had patients in ghastly abundance who had limbs or pieces of skull or even abdominal wall blown away, but only very rarely did men arrive who had gaping wounds of the chest wall. In our ignorance we looked upon chest wounds as "cushy" injuries. We saw only comparatively simple ones caused by "through-and-through" bullets or small lodging missiles. When I went up to the front to act as consultant surgeon to the Third Army I realized why serious cases of staved-in smashed ribs with lacerated open wounds of the chest wall and injured lungs did not reach the base. Practically all of them died. To show you what a sacrifice of life was entailed I quote you statistics of this type of injury in the Third Army during the battle of Arras in April, 1917. In 1 month 1,500 patients with chest wounds were admitted to the casualty clearing stations of that Army. Of these, 500, one-third, were of the serious type which we had not hitherto seen at the base hospitals. Remember this number concerned only 1 month of the war period and only one army out of the five British armies in France.

The development of thoracic surgery during the war was the result chiefly of two methods of treatment of which "no drainage" was one. Quite early in the war it was found that open or "sucking" wounds, those in which a free communication was established with the pleural cavity, were accompanied by great respiratory distress until the hole in the chest wall was closed either by gauze packing or by suture. When this was done the relief of respiratory distress was almost immediate and the patient's condition rapidly improved in other respects also. Of course this procedure was adopted as a "first aid" to enable the wounded man to bear transport more successfully. It was in 1917 that the operative surgery of such wounds was chiefly developed. It was found that patients had to be operated on as early as possible after admission to the casualty clearing stations, otherwise they rapidly succumbed. The lacerated soft tissues and bone of the chest wall were excised, the wound of the lung was attended to, foreign bodies were removed, the pleural cavity wiped clean, and the chest wall closed without drainage. Discarding of drainage made all the difference to the mortality rate. Some surgeons who adopted the procedures I have detailed sent down the line as many as 70 per cent of the cases they operated on and these cases showed every prospect of becoming useful citizens. Later events prove that they have done so. It was one of the bright spots in the surgery of the war. "No drainage" was probably the chief contributory cause once the wound had been cleansed by excision of lacerated and infected tissue. It was found that collapsed lung expanded in an incredibly short time. Even in 24 hours it might be impossible to tell by auscultation alone which side had been operated upon. All that was necessary after operation was to ensure that fluid did not collect in the pleural cavity; therefore, for diagnosis an exploring syringe and if necessary an aspirator was used every day or second day until no fluid could be demonstrated.

The success which attended the treatment of these infected thoracic wounds of war has already stimulated many to apply the same principles of treatment in civil life with conspicuous success in some cases.

In certain cases of empyema, for example, it has been shown that convalescence has been made much shorter and easier for the patient. In these cases, the chest has been laid open freely usually by resecting a long piece of rib, adherent lung has been freed, the pleural cavity carefully cleared, and the wound closed without drainage. Want of success in some cases treated in this manner may be due to faint-heartedness in procedure and in others to selection of the wrong time for operation. Why should some cases heal without trouble while the wounds in others

break down or the pleural cavity have to be re-opened? We must remember that the conditions in the thorax differ widely from those in the abdomen. When the matter is viewed from our old standpoint that the great indication in treatment of inflammation is to give an inflamed part rest, it is very evident that the abdomen has the advantage over the thorax. One can get along quite well for a few days even though movement in the intestine does not occur, but the heart *must* beat and the lungs *must* be inflated periodically in order to maintain life. War surgery has shown that recovery may be very prompt in spite of such movement. In certain types of infection rest, at one time or other of the development of the resultant inflammation, may be essential for cure. For example, from clinical observation alone, I should judge that resistance in a streptococcal infection requires a longer time to develop successfully so that the inflammation becomes localized, than it does in the case of a staphylococcal infection.

Therefore for combatting a streptococcal infection conditions must be very favorable. Pleural effusion may be looked upon as a wise provision of nature in such cases. It limits the amount of movement especially of the lung and thus may turn the scale in favor of success. One may further suppose that if in the general mechanism of resistance to infection the circulating plasma has not been filled with appropriate antibodies it is of little use to withdraw fluid from the chest at this stage. The infective process may still be in full swing and, as it will still stimulate exudation, any radical interference may result simply in the provision of nutrient material which is more suitable for the growth of organisms than was the more or less inert fluid which was removed. The influenza epidemic, which occurred toward the end of the war, furnished numerous cases of pneumonia accompanied by acute empyema due to streptococcal infection. There was much evidence to show that such empyemata did not respond satisfactorily to the ordinary pre-war treatment by immediate drainage. The experience indicated that it is not always wise to make an immediate vigorous attack on the pleural cavity when acute suppurative inflammation is diagnosed. It is wise to ascertain the type of infection present. All the same it may be necessary to remove enough fluid to relieve threatening symptoms caused by pressure on the heart or mediastinum. In a day or two the resistance may be so increased that radical measures will be successful. Examination of the blood constituents may help us to decide when to interfere.

It is different in the abdominal cavity. If rest is necessary, then, when the focus of infection and the accompanying deleterious matter have been removed, the quiescent, sometimes paralytic state of the intestine provides rest while the wonderful powers of absorption of the peritoneum will likely prevent accumulation of nutritive fluid for development of any remaining infection.

In view of these considerations, you may appreciate my hope that, with increased knowledge and scientific application thereof it may prove in future that drainage of the pleural cavity may be dispensed with as safely as drainage of the abdominal cavity is at present.

I hope that I have been able to show you that the same type of treatment can be applied successfully in apparently widely differing disorders. When this is demonstrated then it can be said that definite principles have been established. The main idea of a principle must be right. It remains for us to improve the application of the principle.

DEPARTMENT OF TECHNIQUE

REPEATED VENESECTION–BLOOD TRANSFUSION IN ANURIA

Report of a Case of Acute Nephritis with Anuria

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DURING the past 27 years, surgical thought and endeavor have been applied to many cases of nephritis, and to one of its most serious complications, namely anuria. Operative measures employed, after medical treatment proved unavailing, have been attended with failures in some instances, with the prolongation of life from a few weeks to several years in others, and with reported cures. The percentage of the last two mentioned was sufficiently high to justify a classification of the treatment of nephritis into medical and surgical. The former usually consists in the administration of such measures as will induce (1) diaphoresis, (2) diuresis, (3) catharsis, (4) alkalies to combat acidosis, if present, and (5) venesection. The surgical procedures advocated are, first, the removal of causes, if such be found, that give rise to mechanical obstruction and reflex inhibition of the urinary outflow, e.g., stones, phimosis, blood clot, etc., the treatment being carried out by operative intervention or cystoscopic manipulation, as indicated; second, decapsulation, nephrotomy, or a combination of the two; third, blood transfusion; and last, splanchnic anæsthesia.[1]

We desire to report the use of an additional surgical method, i.e., the combination of repeated venesection transfusions in a case of acute nephritis with anuria.

In addition to decapsulation of the right kidney (which was unsuccessful in producing any immediate beneficial effects), the patient was bled 500 cubic centimeters, and was then immediately transfused with an equivalent amount of blood from a healthy donor. The criteria that determined the frequency of this procedure were based on the clinical condition of the patient, the blood chemistry findings, and the amount of urine excreted in 24 hours. It was found necessary to use four venesection transfusions.

[1] Neuwirt employs splanchnic anæsthesia (Kappis technique) in reflex anurias.

HISTORY OF CASE

L. S., a white boy, age 11, was admitted to the medical service of the City Hospital, July 29, 1923, in a mild state of apathy, complaining of severe frontal headache and of a continuous dull pain in the right lumbar region. It was stated by the parents that the patient had not urinated during the past 6 days, suppression developing shortly after the occurrence of an infected contusion of the finger which was incised and drained. The physician, returning on the second day of illness, reduced a partial phimosis. Œdema and swelling of the prepuce followed this manipulation. Previously, the patient had always been healthy and well, excepting for an attack of typhus fever when 8 years of age.

Physical examination. The patient presented the appearance of a well nourished and well developed boy, who seemed not acutely ill. On admission to hospital temperature was 36.7 degrees C.; pulse, 80; respiration, 20; blood pressure, 120-40.

A small infected wound of the right ring finger was associated with moderately enlarged epitrochlear and axillary glands, there being no evidence, however, of a superficial lymphangitis.

There were no evidences of a distended bladder in the hypogastrium or on rectal examination. When catheterizing, some difficulty was encountered at the meatus, due to an incomplete exposure from the recently acquired phimosis. The passage of a soft rubber catheter revealed an empty bladder.

A moderate amount of tenderness to light fist percussion was elicited only over the right kidney posteriorly. The kidneys were not palpable.

The face presented only a suggestion of œdema, while the ankles and feet pitted slightly on deep pressure. There were no evidences of free fluid in the peritoneal cavity. No abnormalities or pathology could be discovered in head and neck. The buccal mucous membranes were normal in color; the tonsils small and of normal appearance; the teeth in good condition; the tongue moist, but heavily coated. Respiration was costo-abdominal in type. No pathology was discoverable in the heart or lungs. The contour of the abdomen was normal. No tenderness or rigidity could be palpated, and no masses were found. The liver and spleen were not palpable, and were percussed out within normal limits. There was slight œdema of the ankles and feet, otherwise normal. The muscular reflexes were normally active.

Additional data as follows:

1. X-ray pictures of the genito-urinary tract showed normal kidney outlines; there were no shadows suggestive of calculi.

TABLE I

Date 1923	24 hr. fluid intake in c.cm.	24 hr. urinary output in c.cm.	Blood Chemistry mg. per 100 c.cm.		Blood pressure	Remarks
			Urea	Creatinine		
7–30	2000	0	.....	.....	120–65	Vomiting. Entire quan. (saline) given subcut. and intrav.
7–31	3000	0	146.0	8.5	.....	Vomiting. Entire quan. (saline) given subcut. and intrav. Bloody urine.
8–1	300	5	295.0	11.25	130–82	*Decapsulation.* Entire quan. (10 per cent glucose) given intrav. Bloody urine from cath.
8–2	500	5	319.0	11.25	130–85	No vomiting. ½ of this quan. was saline, intrav., other half, fluid by mouth. **Venesection transfusion.*
8–3	870	150	.....	.....	132–78	Fluid by mouth only, and was retained. Bloody urine.
8–4	1500	250	228.0 175.0	10.0 9.0	138–80	Fluid by mouth only, and was retained. Bloody urine. **Venesection transfusion.* Findings one hour before proced. Findings one hour after proced.
8–5	1000	350	.....	.....	132–78	No vomiting. All fluid by mouth. Bloody urine. Drowsiness disapp.
8–6	600	0	264.0	11.43	.....	Vomiting, headache, drowsiness returning. Although much fluid was given, only 600 cubic centimeters retained.
8–7	600	200	.....	.....	134–78	Vomiting, headache, drowiness returning. Although much fluid was given, only 600 cubic centimeters retained. Sl. bloody urine. Anuria on 8–6, pbly. reflex.
8–8	1000	350	.....	.....	137–79	Sl. emesis., Sl. bloody urine. **Venesection transfusion.*
8–9	1500	500	.....	.....	139–78	Sensorium clear. Irritabil. and restlessness disappearing.
8–10	1000	350	272.0	10.0	146–84	Sensorium cloudy. Œdema of ankles, feet, and scrotum.
8–11	1620	350	.....	.....	.....	Sensorium cloudy. Œdema of ankles, feet, and scrotum. **Venesection transfusion.*
8–12	1984	700	.....	.....	.....	Sensorium again clear. Does not sleep, but gen'l condit. improv.
8–13	2000	900	.....	.....	148–88	Sensorium again clear. Does not sleep, but gen'l condit. improv.
8–14	2000	1000	175.0	6.9	155–95	Sensorium again clear. Does not sleep, but gen'l condit. improv.
8–15	2000	1100	.....	.....	144–70	Sleeps at intervals. Œdema disapp.
8–16	2000	1200	.....	.....	.....	Vomiting. Irritable. No drowsiness.
8–17	2000	1450	38.0	4.2	142–74	Sleeps well. Appetite poor.
8–18	2000	1100	.....	.....	140–76	Sleeps well. Appetite poor.
8–19	2000	1300	.....	.....	.....	Appetite good. Free of all prev. symptoms. Œdema still present.
10–3	2000	16–2500	19.0	1.2	118 72	Up in chair. Œdema has disapp. Is free of all symptoms.
11–30	2000	16–2500	42.0	2.5	112–68	No œdema present. Sensorium clear. There is a residual chronic nephritis.

*Urea

2. No obstruction was offered to the passage of a No. 16 F. cystoscope, which revealed a normal bladder with normal ureteral orifices. The ureters were not catheterized.

3. Dr. H. Shiras, attending ophthalmologist, examined the eye grounds, and reported normal findings.

Tables II and III show Laboratory Data.

Operation. In view of the fact that conservative treatment for 2½ days had caused no abatement of uræmic symptoms and that there was an increasing accumulation of urea and creatinine in the blood since admission, the patient was transferred to the surgical division, August 1, 1923, when decapsulation of the right kidney was performed under regional local anæsthesia. At operation, considerable œdema of the perirenal tissues was found; the true capsule was not under tension, and was adherent at two or three points along the convex border; the kidney appeared normal in size, dark in color, and separate and confluent hæmorrhagic areas were visible on the surface of the organ. The fibrous capsule was stripped down to the pedicle on both sides and cut away. The usual closure of the wound was made. A dorsal slit of the inflamed prepuce was made, and an indwelling catheter inserted in the bladder.

VENESECTION TRANSFUSION

Through a personal communication with Dr. H. L. Sanford, we obtained information concerning a case of bichloride of mercury poisoning which had come under his observation and care at the St. Alexis Hospital in May, 1923. The patient, a woman of 22 years, had an anuria which lasted 48 hours, during which time the routine methods of inducing an excretion of urine had been employed without avail. Repeated venesection transfusions were then resorted to, following the first of which there was an appearance of urine in small amounts

TABLE II.—URINE EXAMINATIONS

Date 1923	Sp. gravity	Albumin	W.B.C.	R.B.C.	Casts
7–31	insuff. quan.	++	+++	++++	Many granular Few hyaline
8–2	insuff. quan.	++	++	++++	Many granular Few hyaline
8–4	insuff. quan.	++	++	++++	Many granular Few hyaline
8–5	1012	++++	++++	++++	Many cellular
8–7	1016	++++	++++	+++	Many cellular
8–14	1010	++++	+++	++	Few cellular
8–15	1016	++++	+++	++	None
8–20	1012	++++	+++	++	None
9–5	1010	+++	+	++	Occas. hyal.
9–7	1015	++	+	++	None
9–8	1011	+++	+	++	None
9–9	1011	++	+	+	Few hyaline Few granular
9–11	1010	++	+	+	Few hyaline Few granular
9–12	1012	+	+	o	Few hyaline Few granular
9–14	1013	+	+	+	Few hyaline Few granular
9–18	1012	+	+	+	Few hyaline Few granular
9–21	1016	+	+	+	Few hyaline Few granular
10–1	1010	++	++	+	Occas. hyal.
10–19	1015	++	+	o	Few hyaline Few granular
10–22	1012	++	++	o	Few hyaline Few granular
10–27	1010	++	+	+	Occas. hyal.
11–2	1018	++	+	+	None
11–9	1016	+++	++	+	None
11–14	1015	+++	++	+	None
11–21	1018	+++	+	o	None
11–27	1017	+++	o	o	None
12–2	1016	+++	+	o	Mod. no. hyal.
12–7	1014	+++	o	o	None

+= 5 to 10 cells per low power field.
++=10 to 20 cells per low power field.
+++=20 to 30 cells per low power field.
++++=30 and above cells per low power field.

during the ensuing 24 hours, a definite amount of urine (no measurement recorded) was obtained from the bladder by a catheter, and it is certain that the amount of urine increased rapidly until the time of the patient's death, which occurred on the eighth day after admission. It was impossible to estimate the exact amount of urine, since it was lost at the time of defæcation, as many as 15 to 20 bowel movements being noted per day.

TABLE III A.—PHENOLSULPHONEPHTHALEIN

Date 1923	1st hr.%	2nd hr.%	3rd hr.%	Total %
10–4	20	25	.....	45
11–22	38	10	5	53
11–30	40	15	10	60

TABLE III B.—MOSENTHAL TEST

Date	Hour	Sp. grav.
	8 A.M.	1016
	10	1017
11–21	12	1018
to	2	1018
11–22	4	1018
	6	1015
	8 P.M.	1016
	night	1014

TABLE III C.—BLOOD EXAMINATION

Date 1923	7–29	8–1	11–30
W.B.C.	14,400	16,000	17,200
R.B.C.	.....	4,800,000	3,120,000
Hb. (Talqv.)	90%	85%	70%

TABLE III D.—ESBACH

Date	Gms. alb. per liter.
9–5	2.6
11–4	2.0
11–21	1.65

Blood Wassermann.....negative.
Blood Culture.....negative after 72 hours.

With a knowledge of Dr. Sanford's experience in the above instance, and of the observations of Robertson and Boyd in the treatment of toxæmias of severe burns by means of exsanguination-transfusion, we were led to the adoption of repeated venesection transfusion in the case here reported.

In Table I, the chemistry figures shown on August 4, 1923, were from samples taken 1 hour before and 1 hour after venesection transfusion, there being a drop of 53 milligrams of urea and 1 milligram of creatinine per 100 cubic centimeters of blood immediately afterward. This lowering was, however, temporary since on August 6, 1923, a marked accumulation was found. Following the last (fourth) venesection transfusion, the urea and creatinine continued to diminish until almost normal figures were obtained 3 weeks later. It was also noted that following each of the four treatments, there was an immediate and complete disappearance of all uræmic symptoms lasting from 12 to 48 hours.

In regard to the excretion of urine, the following was noted: (1) After first venesection transfusion, 145 cubic centimeters in the ensuing 24 hours;

(2) after second venesection transfusion, 100 cubic centimeters in the ensuing 24 hours; (3) after third venesection transfusion, 150 cubic centimeters in the ensuing 24 hours; (4) after fourth venesection transfusion, 350 cubic centimeters in the ensuing 24 hours.

BLOOD CHEMISTRY

V. C. Myers states that those cases in which the creatinine had risen above 5 milligrams per 100 cubic centimeters of blood, rarely showed any marked improvement, and almost invariably died within a comparatively limited time. The only exceptions were cases where the retention was due to some acute renal condition. The highest blood creatinine with ultimate recovery, observed by Myers, occurred in a patient developing anuria following a unilateral pyelogram and displacement of a renal calculus. This case was reported by McCarthy (14), the creatinine content reaching 23.1 milligrams per 100 cubic centimeters.

Feinblatt found that in 14 patients attaining figures of 10 milligrams per 100 cubic centimeters or more, all died within less than 3 weeks, the average length of life after reaching this figure being 4 days; and that of 15 patients who yielded figures between 5 and 10 milligrams, 11 died uræmic within 17 days, the average being 6 days. He cites two cases to emphasize the fact that with a retention of creatinine exceeding 5 milligrams, the prognosis as regards the renal condition, while grave, is not necessarily hopeless.

In the case under our observation, the highest blood creatinine content was 11.43 milligrams per 100 cubic centimeters with recovery as far as life is concerned thus far (7 months), but with a residual chronic nephritis.

VENESECTION

It seems quite obvious that any benefits resulting from one or two venesections would not only be exceedingly fleeting, but would also be overshadowed by increasing an anæmia which is usually already present, particularly if the procedure were employed a greater number of times.

Rost quotes Becker in that his experiments have shown that venesection does not constitute a detoxifying process; on the contrary, the amount of retained nitrogen in the blood as well as in the tissues increases. The statement that is frequently made, viz., that dilution of the toxins and washing out of the tissues take place is, therefore, incorrect.

DECAPSULATION

That the true capsule of the kidney offers an impediment to a new vascularization (Edebohl's conception in chronic nephritis) need not be taken into consideration in an explanation of the results obtained in acute cases, since it has been noted that the urinary flow begins and increases either immediately, in the ensuing 24 hours, or 36 to 48 hours after operation.

In regard to the modus operandi of decapsulation in effecting diuresis in acute cases, several explanations have been offered, some of which are as follows:

1. It relieves congestion by permitting the kidney to expand. Simulation of the tension is made to that in glaucoma of the eye by Harrison, who first reported on the surgical treatment of acute nephritis in 1896, obtaining beneficial results by kidney puncture.

2. The capsule being under marked tension, constriction of the vessels at the hilus results. This may be a factor in addition to the nephritis in causing renal circulatory stasis. Incision and stripping of the capsule not only releases the pull on the vessels and the intrarenal tension, but the necessary operative manipulation according to Lloyd, is attended by an abstraction of more or less blood from the organ, while following operation, the flow of serum probably still further decreases congestion.

3. In a complete stripping operation, the nervous mechanism of the kidney, particularly at the hilus is partially or completely damaged, thus leading to an increased flow of urine. This theory is based upon the fact that section of the splanchnic nerve in animals causes a polyuria. Neuwirt blocks the splanchnic nerve with local anæsthetic in conditions of reflex anuria and oliguria in man, claiming the same effect as when the nerve is severed.

Ertzbischoff quotes Jaboulay to the effect that the changes arising in the renal circulation after decapsulation may be attributed to a stretching of the sympathetic nerve fibers in the pedicle, and that Albarran performed a total decortication in order to enervate the kidney as completely as possible. This conception is, however, questionable.

Rost, in a general review, states that although decapsulation has yielded good results in some cases of anuria, yet it is not astonishing to read of failures, many of which can be attributed to kidneys previously the seat of irreparable pathology (marked hydronephrosis, cystic disease, old contracted kidneys, etc.)

Sanderson-Wells states that decapsulation is an emergency operation in anuria, and although from the physiological and pathological standpoints, the outlook appears disappointing, from the clinical aspect the result is quite different.

Eppinger, Kummell and other observers hold that no cases of acute nephritis should be deprived of the chance decapsulation may offer as to prolongation of life after medical treatment has proven futile.

COMMENT

From a purely scientific viewpoint we regret that both decapsulation and venesection-transfusions were used, leading to possible confusion as to which procedure effected the result. Clinically, however, upon being confronted by such a desperate case, we felt it only justifiable not to omit decapsulation.

A question of considerable importance then is, would the excretion of urine have taken place without surgical intervention, and if not, were the results attributable to decapsulation, repeated venesection transfusions, or the combination? It is an old observation that spontaneous resolution may sometimes occur in acute nephritis, but one cannot deduce accurate conclusions from cases in which no blood chemistry findings were reported.[1] In regard to the second question, that of decapsulation, we are of the opinion that at least the immediate beneficial effects of the operation can be ruled out, since the kidney was normal in size, there was no tension on its capsule, and only 10 cubic centimeters of urine was excreted in the ensuing 24 hours. Concerning the remote effect of decapsulation (which is said to begin about 10 days after operation; this is spoken of by Edebohl in regard to chronic nephritis), it will be noted (Table I) that on the eleventh day after operation 700 cubic centimeters of urine were excreted, and from that date onward there was a continuous rise reaching as much as 2,500 cubic centimeters of urine per day, 3 weeks after decapsulation. It should be noted, however, that venesection-transfusion, performed on the tenth day after operation because of the high blood figures and of uræmic symptoms, resulted in a definite and marked relief of the latter. There seems to be general agreement that the beneficial effects of decapsulation are immediate, i.e., not longer than 48 hours. Therefore there remains considerable doubt as to the late effect of decapsulation in this instance.

In perhaps a somewhat analogous sense, as colostomy, jejunostomy, etc., are at times life-saving measures in acute intestinal obstruction, employed to prevent an absorption of toxic bodies by diverting the alimentary stream, may we not consider the use of repeated venesection transfusions similarly in acute renal damage, as effecting a direct, definite but temporary, intermittent diversion of nitrogenous waste and toxins by way of the blood stream, and indirectly through the blood stream by possibly stimulating the excretion of urine?

[1] There were no satisfactory methods for estimating the creatinine content of the blood prior to 1914 (Folin and Denis).

CONCLUSIONS

1. Repeated venesection transfusion is a logical procedure in acute conditions interfering with the permeability of the kidneys, in that it lowers the amount of accumulated catabolic products in the blood, not only by frequent removal but also by repeated dilution of the remaining circulating blood.

2. It is a more logical procedure than a single venesection transfusion, since it is inconceivable that the tissues could be detoxified for a sufficient length of time to admit of much benefit.

3. It tides the patient over a critical period until the kidneys can again resume their function.

4. It can be used as an accessory measure but should not supplant renal decapsulation which is a recognized useful procedure in nephritis.

5. The frequency and number given in any case should depend upon the clinical condition of the patient, the blood chemistry findings, and the quantity of urine excreted in 24 hours.

6. We ascribe an important rôle to repeated venesection transfusion in the recovery of our patient, since there was no tension that could be relieved by decapsulation, and no diuretic effect was obtained following the operation.

Realizing that no far reaching conclusions can be deduced from observations in a single case, nevertheless we thought it of some value to record our findings, and we shall view with much interest observations by others who might choose to adopt the procedure herein described.

The blood chemistry was performed by Doctors Ralph H. Monger and Clarence M. Hyland.

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LOOSE BODY IN KNEE JOINT DEMONSTRATED BY PNEUMARTHROSIS[1]

By IRVIN BALENSWEIG, B.S., M.D., New York

Clinical Instructor, Orthopedic Surgery, Cornell University Medical College; Assistant Surgeon, Hospital for Ruptured and Crippled, Out Patient Department; Assistant Visiting Surgeon, City Hospital

THE injection of oxygen or other gases into joints for diagnostic purposes is not a new procedure but one that is not used as often as it should be. Its greatest use is in the doubtful cases of internal derangement of the knee joint. Negative X-ray findings need not deter one from attempting further observation or operation. The procedure is harmless in so far as it does not cause much pain, is not a disabling one, and there is no resulting joint traumatism. There have been no complications noted to date at the Hospital for Ruptured and Crippled where some forty joints have been inflated.

The method used is as follows:

The patient may be given a small dose of morphine 20 minutes before operation and the part is prepared in the usual manner. A 3-inch sterile needle is inserted into the joint from either the medial or lateral aspect avoiding the fat pad, and whatever fluid is found to be present is withdrawn with a syringe. Sterile rubber tubing is then attached to the needle and to the tank containing oxygen. The joint is then gradually distended until the patient complains of tightness and pain, when the X-ray pictures are taken in both the anterior and lateral planes. When this is done, the rubber tubing is detached and the gas is forced out of the joint by bi-manual manipulation. The part is then dressed and a gauze bandage applied, there being no need for any immobilizing apparatus.

CASE REPORT

A. B., schoolboy, age 16, presented himself at the clinic of the Hospital for Ruptured and Crippled, December 13, 1923, complaining of pain and occasional locking of his left knee. He was well up to 1 year ago when a schoolmate approached him from behind striking him across both knees, thus causing a sudden flexion of knee joints. He fell forward and struck the floor. On arising it was impossible completely to extend the left knee joint. This persisted for 1 week and was accompanied by swelling. He has since then never been free from an occasional failure to extend the joint and has pain when exercising. For the past 3 months these attacks have become more frequent, as many as two and three times a day, lasting for a few minutes. The pain shifts from side to side and together with it, a snapping sensation is felt.

Examination. The patient is a well developed, overnourished and rather obese young white male, weight, 169 pounds. He presents a slight double knock-knee deformity and double weak feet. Locally, the left knee is somewhat swollen. There is no restriction of motion, no pain and no point of tenderness, nor any evidence of locking or snapping. The left knee measures one-half inch greater than the right in circumference.

Roentgen-ray pictures taken December 13, 1923, reveal the following: In the right knee there is no evidence of pathology; in the left the anteroposterior view is negative. The lateral, however, shows the presence of a small shadow of less density than bone, regular in outline and measuring 5 by 3

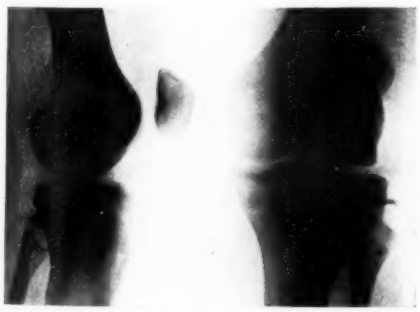


Fig. 1. Lateral and anteroposterior views prior to oxygen injection.

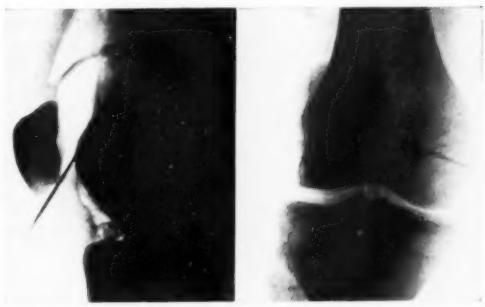


Fig. 2. Lateral and anteroposterior views following oxygen injection.

[1] This paper was presented before the Orthopedic Section of the Academy of Medicine, New York, January 19, 1924.

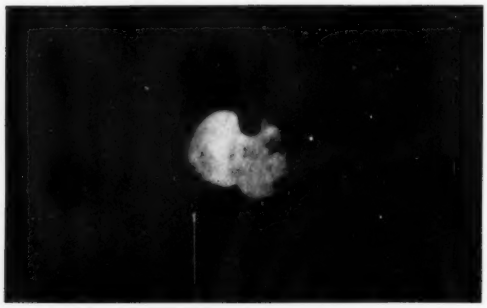


Fig. 3. Photograph of specimen (actual size).

millimeters and situated 1 centimeter behind the anterior tibial border.

On December 17, 1923, oxygen was injected according to the technique described. Before injecting the oxygen, 2 ounces of straw colored synovial fluid was withdrawn. The X-ray films now revealed in the anteroposterior view a spherical shadow 8 millimeters in diameter located between the tibial spinous processes. In the lateral view there was a similar shadow attached by its inferior pole to the upper surface of the tibia 1 centimeter posterior to its anterior border.

On December 19, with the patient anæsthetized, an Esmarch bandage was applied to the upper third of the left thigh. A 5-inch vertical incision curved at both ends, and one-half inch medial to the patella, was made. The joint was incised in the line of the incision which extended upward between the vastus internus and the quadriceps tendon, thus giving an excellent exposure. About 2 ounces of brown colored synovial fluid was evacuated. The synovial tissue was not thickened, but was found to be discolored as a result of punctate hæmorrhages in the neighborhood of the needle insertion. The medial semilunar cartilage was completely detached from the tibial border and located between the femoral condyles. It was removed in its entirety. On further exploration of the joint, a small body as previously described was found to be attached to the tibia by a membranous pedicle at the point of origin of the medial semilunar cartilage. This mass was also excised. Investigation of the lateral cartilage proved it to be normal in all respects. The joint was irrigated with saline and closed in layers, using No. 00 chromic catgut for the approximation of the synovia, No. 0 chromic for the closure of the capsule and the suturing of the vastus internus to the quadriceps tendon; and No. 1 catgut for the approximation of the subcutaneous tissues and the skin. Dry dressing was applied, and the patient was returned to the ward.

February 7, 1924. The postoperative course was uneventful, the patient being allowed home on the fourteenth day walking without apparatus and but slight discomfort. The range of motion now possible is from complete extension to 120 degrees of flexion. Since January 7, the patient has been at school, relieved of all symptoms.

The pathological examination of the loose body reveals the pedicle to consist of fibrous tissue attached directly to bone at the hilus. The covering of the mass is a thin layer of cartilage except at the point of attachment. The origin of this body can be considered to be from a small detachment of the medial semilunar cartilage at the time of the first injury, followed by hypertrophy and bone formation as a result of repeated traumatisms, the blood supply coming through the pedicle.

SUMMARY

The method herein described was a distinct aid in both localizing and differentiating the loose body from the surrounding tissues.

INSULIN TREATMENT OF THE TOXÆMIC VOMITING OF PREGNANCY[1]

By WILLIAM THALHIMER, M.D., Milwaukee
From the Laboratories of Columbia Hospital

EIGHT patients with pernicious vomiting of pregnancy have been successfully treated with insulin combined with the intravenous administration of glucose, five of these having been reported previously.[2] The report of the three additional patients follows.

I am indebted to Dr. E. C. Walter, of Mayfield, Kentucky, for the following case report.

Case 1. Mrs. S., age 30, a multipara, menstruated last in November, was seen by us in consultation on March 5. At that time she had been vomiting constantly over a period of 3 weeks. She had been able to retain practically no food or water over this time, and was obtaining only fluids by means of Murphy drip. Pulse 140, weak; eyes sunken with yellowish tinge, general condition bad. Patient was brought to the Mayfield Hospital the evening of March 5, and vomited all night. March 6, urine was scanty, acetone 4 plus. At 10:15 a.m. an intravenous solution of 5 per cent glucose was started, was continued until 2,000 cubic centimeters had been given (1:15 p.m.). During this time 30 units of H 10 iletin were given. At 12:00 p.m. the urine showed a marked trace of acetone. At 4:00 p.m. the urine was negative for acetone. The patient was given some orange juice and slept well all that night. She has had no nausea or vomiting since that time, and was discharged from the hospital in excellent condition.

Case 2. The patient, a primipara, 30 years old, was admitted to Milwaukee Hospital under the care of Dr. H. W. Shutter, March 12, 1924. She was 10 weeks pregnant and had been vomiting 10 or 12 times a day for 6 weeks. She appeared moderately dehydrated. Her pulse was small and weak; its rate 140. Her urine contained 3 plus acetone and diacetic acid. For 24 hours she was given rectal feedings of glucose combined with chloral or bromides. Her condition remained unchanged and the ketonuria remained the same. The day after admission, at 11:00 a.m. she was given 550 cubic centimeters of 10 per cent glucose solution intravenously during a period of 1½ hours, and 10 units of insulin were given also. At 12:10 p.m. she was given another 10 units of insulin. At 5:00 p.m. acetone in the urine was 2 plus. At 6:30 p.m. she was given 20 units of insulin. She vomited only twice in the 12 hours after the beginning of the glucose infusion. The following morning her urine contained acetone in from 1 to 2 plus amounts. At 11:00 a.m. 500 cubic centimeters of 10 per cent glucose were given intravenously and 15 units of insulin. This day she vomited twice. The following day, which was the second day after treatment was begun, she vomited twice and received 10 units of insulin. She vomited once on the third day after treatment was begun. Her urine still contained 2 plus acetone, but on the fourth day following treatment the urine was negative for acetone and no further acetone appeared.

The patient began to take food shortly after the first treatment was given and in spite of occasional spells of vomiting, she continued to eat and in fact craved food and ate more than the average individual.

The patient left the hospital in about 10 days in good condition and has remained so.

The following report is of a patient kindly referred to me by Dr. C. M. Echols.

Case 3. The patient, age 27, a primipara, was admitted to Columbia Hospital, April 11, 1924, at noon. She was about 5½ months pregnant and had had a moderate amount of nausea and vomiting during the first 3 months of her pregnancy, then for 2 or 3 weeks there was none. During the 10 days previous to her admission to the hospital, she had been unable to retain either food or liquids.

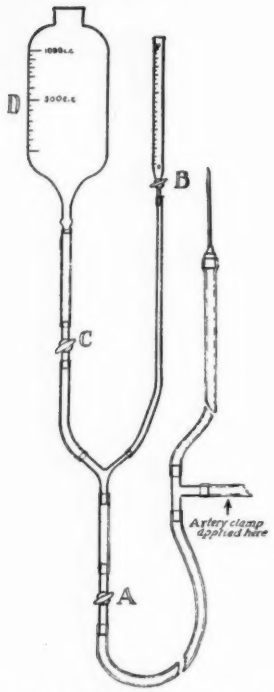
She was in very poor condition when she entered the hospital, being moderately dehydrated. Her eyes were sunken and had dark rings about them. The pulse was small, rate 140. The urine had 4 plus acetone and diacetic acid and the blood alkali reserve (Van Slyke method) was 35; the blood sugar was 0.15 per cent. At 1:00 p.m. intravenous glucose administration was started and in 3 hours 1,000 cubic centimeters of 10 per cent glucose was administered. During this time 30 units of insulin were given hypodermically. At the end of this time the alkali reserve was 48 and was 69 the following morning. The patient retained a moderate amount of food immediately after this procedure and slept well that night without any narcotics, having required a dose of morphine every night for the 10 days before admission. Five hours after the treatment was started the urine showed 3 plus acetone and 2 plus diacetic acid; 18 hours later the urine showed 2 plus acetone and 1 plus diacetic; 36 hours after the beginning of the treatment the urine showed 1 plus acetone and diacetic acid. The patient continued to vomit 2 or 3 times a day for 3 days, and as at this time the urine still showed 1 plus acetone and diacetic acid, even though the alkali reserve was 67, the glucose and insulin treatment outlined above was repeated. Immediately after this the urine became acetone free and has remained so. The patient is now, one week after admission, on a normal diet, is retaining all of her food and is almost ready to leave the hospital.

All of these patients showed marked ketonuria and one of them was proved to have a moderately severe acidosis, as indicated by a carbon-dioxide combining power of the blood plasma of 35 (Van Slyke method). Three hours later at the end of the intravenous infusion of glucose and the administration of insulin, the blood plasma carbon-dioxide combining power was 48, and 19 hours later it was 69.

As previously pointed out the rapid eradication of ketonuria, and even of acidosis, by combined insulin and glucose therapy seems to cause relief of the nausea and vomiting in these

[2] Thalhimer, William. J. Am. M. Ass., 1924, lxxxii, 696.

[1] Read before the Chicago Gynecological Society, April 18, 1924.



Apparatus used in administering glucose solution.

non-diabetic patients. A vicious cycle of acidosis causing vomiting, and the starvation following the vomiting causing further acidosis of a starvation type, seems to establish itself in these patients. Insulin helps break this cycle by forcing the body to oxidize the administered glucose, which in turn causes the burning of the products of incomplete fat metabolism (acetone, aceto-acetic acid, B-oxybutyric acid). This reduces or eliminates the ketonuria; the lowered blood plasma carbon-dioxide combining power is raised, and this removal of the acidosis eradicates the chief cause of the severe nausea and vomiting. Food is then retained, and with a proper diet, rich in carbohydrates, nausea and vomiting (except to a slight degree in the morning) usually does not return.

Evidence is accumulating, both in the literature and in my investigations, which indicates that pregnancy itself causes an abnormality in the carbohydrate metabolism which may be the fundamental cause of excessive vomiting of pregnancy. There are still several gaps in this evidence and I will reserve publication of the available data for another time. It is possible that the acidosis found in *severe* vomiting of pregnancy is due not only to a deficient supply of carbohydrate, but also to either an actual reduced ability of the mother to utilize carbohydrate, or to the excessive demand of the growing embryo, membranes and uterus for carbohydrate.

APPENDIX

The glucose solution is given by means of an apparatus previously described.[1] The solution is prepared as follows:

Sterilize at 15 pounds pressure for 30 minutes, measuring cups, funnels, filter paper, stirring rods, and distilled water in flasks plugged and covered with gauze.

Measure out into sterile basins 100 grams dextrose (Merck) *highest purity "C.P." anhydrous*. (This is a special preparation and better than ordinary C.P. dextrose.) While the water is still warm, a nurse puts on gloves, and is assisted by another nurse who pours the dextrose from basins and the sterile water from flasks into measuring cups to 1,000 cubic centimeters. The first nurse mixes this thoroughly, filters and measures 1,000 cubic centimeters back into flasks which are plugged and covered with sterile gauze by the second nurse. By having all materials sterile before mixing the dextrose (the only non-sterile ingredient) with the water, bacterial growth is minimized.

Sterilize the mixture for 30 minutes in an autoclave at 9 to 10 pounds pressure. Do not allow the steam pressure to go above 10 pounds, as carmelization takes place, and the solution changes to a brownish color. Only a water clear, colorless solution should be used. At end of 30 minutes, close off all steam and do not open door or release pressure for 10 minutes. Then open the door very slowly and carefully, and remove flasks from sterilizer *immediately*. Keep in a cool place, or better, in an ice box.

THE ESSENTIALS OF THE INSULIN AND GLUCOSE METHOD OF TREATING PATIENTS WITH SEVERE POSTOPERATIVE ACIDOSIS OR SEVERE VOMITING OF PREGNANCY

Only those cases should be treated with this method which have a severe acidosis. This should be determined, first by demonstrating large amounts of acetone and diacetic acid in the urine, or by demonstrating a blood alkali reserve of 45 or less, but most of the cases treated up to date have shown an alkali reserve of about 40 (the figure for a normal alkali re-

[1] Thalhimer, William. J. Am. M. Ass., 1922, lxxviii, 190.

serve being 60). When it has been determined that severe acidosis is present, 1,000 cubic centimeters of 10 per cent glucose solution should be slowly given intravenously. The time consumed in giving this amount is 4 to 5 hours. One hour after the intravenous infusion has been running, 20 units of U.20 iletin (that is 1 cubic centimeter) should be given hypodermically. An hour later 10 units of U.20 iletin (½ cubic centimeter) is given hypodermically. No patient has ever had an insulin reaction after these doses.

In case marked improvement of the patient's general condition and of the acidosis has not occurred in 12 hours, the above procedure should be repeated, and it is better never to give a dose of insulin to a non-diabetic patient without at the same time administering a proper amount of glucose, either hypodermically or intravenously, since one can only be sure of absorption of the glucose when it is administered by one of these two routes.

While the glucose is running, the patient should not be left alone for a minute and should be seen frequently by a physician; and a sterile hypodermic syringe and a bottle of adrenalin should always be available in the patient's room. If an insulin reaction occurs, from 3 to 5 minims of adrenalin should be given hypodermically at once, followed by more glucose intravenously or by carbohydrate food by mouth.

If in your clinical judgment the patient is greatly dehydrated at the beginning of the treatment, give 2,000 cubic centimeters of 1 per cent glucose solution instead of 1,000 cubic centimeters of 10 per cent.

RESULTS

The patient's urine becomes acetone free in about 12 hours and the alkali reserve rises about 10 points. Vomiting usually either entirely or almost entirely ceases shortly after treatment is begun. A small amount of acetone usually reappears in the urine in 18 to 24 hours, but if the patient is retaining food and is in good condition otherwise, unless the acetone markedly increases or the alkali reserve falls abruptly, further treatment is usually not necessary. Carbohydrate food, particularly, should be given in moderately large quantities as soon as the patient will retain it (skim milk, orange juice, lemonade with sugar in it, tea or coffee with sugar in it, gruels, etc.). (At first give no cream, butter, or fat.) Give plenty of fluids. After the vomiting has ceased for about 24 hours, allow the patient's appetite to dictate the kind of foods, still bearing in mind that carbohydrates should be prominent in the dietary and fats should be absent.

Blood should be obtained for examination at the time the intravenous infusion is started if it has not been obtained previously. This is important for the sake of records and observation. A sample of blood should be examined 24 hours later, also.

TREATMENT OF INSULIN REACTION

Only one patient had an insulin reaction. As she was extremely ill she had received in her first treatment 1,000 cubic centimeters of 10 per cent glucose solution intravenously, and 30 units of insulin followed by an additional 10 units of insulin several hours later. This caused no reaction. The next day the treatment was repeated but 40 units of insulin were administered while the intravenous glucose was being administered. Shortly after the intravenous infusion was finished, she had a definite insulin reaction. She responded immediately when 3 minims of adrenalin were given hypodermically and 2 glasses of milk were given by mouth. Although she had been vomiting, she retained all the milk.

WRIST UNDER CHIN A CAUSE OF DEFLECTION MANUAL ROTATION IN DEEP TRANSVERSE ARREST

By GEORGE EDWARD BARNES, B.A., M.D., Herkimer, New York

ON October 10, 1923, I attended a case of labor in which I made an observation on a cause of deflexion attitude which, so far as I know, has never before been made.

During the last 2 weeks of pregnancy the child's vertex rested on and slightly in the pelvic brim, occipito-dextra transversa. Early in labor abdominal examination showed that this position still existed. The first rectal examination found the head in the transverse diameter of the pelvis and the two fontanels on the same level, that is, there was a median vertex presentation, "military attitude." Occasional rectal examinations during descent continued to find these relations unchanged.

After the head had descended well it failed to rotate. Flexion did not take place spontaneously and I could not produce it by pressure upward on the sinciput either through the rectum at first or through the vagina later. Each time I pressed on the forehead there was no more yielding than occurs when pressure is made on a piece of tough rubber.

The head had apparently come to a standstill. The patient was becoming weary and fretful and the pains were becoming weaker. I resolved to accomplish all I possibly could before resorting to forceps, which is not a delectable thing in deep transverse arrest. The membranes were ruptured. I inserted my right hand into the vagina, placed my fingers on the posterior aspect of the occiput and my thumb on the anterior aspect of the forehead and I placed my left hand on the fundus. During the next pain I made pressure downward on the fundus with my left hand, forward on the occiput with the fingers and backward with the thumb of my right hand. The head rotated very slightly but when the pain ended and my hold was relaxed it went back to the transverse position. I repeated this maneuver with succeeding pains, holding the head so that it would not return between the pains, and after a time the head was brought into full rotation and came under the pubic arch.

I continued the Kristeller expression and the head gradually progressed and was born. As soon as the bony and soft parts of the outlet permitted, the head turned again so that it was in the transverse position, occiput to the right. As the chin emerged I observed that one wrist was held firmly beneath it, effectively preventing flexion. It is very probable that such locking of the wrist, hand, or forearm between the chin and chest may be a very frequent cause of moderate deflexion and that this condition may be the initiating factor which allows other causes to act in producing greater degrees of deflexion.

(Parenthetically, I may say that once before I fully delivered a baby by making pressure on the fundus. It was on 44th Street, New York City, about twenty years ago, before I ever heard of Kristeller. The case was normal except that it was complicated by the most marked diastasis of the recti muscles that I have ever seen. With each pain the uterus bulged out between the recti and I replaced the action of the abdominal muscles with my hands until the baby was born).

It seems to me that the bimanual treatment used in this case of deflexion is, when possible, preferable to the employment of forceps in rotating the head forward in cases of deep transverse arrest and it seems as if it should usually be possible. The head was rotated without being fully followed by the body. That is, the neck was twisted. Forceps would doubtless have twisted the neck in the same manner. The child has been in perfect condition.

The fixation of the wrist under the chin having now been discovered as a cause of deflexion, the question arises whether it is possible, while the head is in the pelvis, to remove the wrist from its abnormal position. Is it possible, with or without ether relaxation and anæsthesia, to pass the fingers up beside the head, dislodge the interfering member, and then flex the head by pushing upward on the forehead and downward on the buttocks in the fundus?

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D.....Managing Editor
ALLEN B. KANAVEL, M.D.....Associate Editor

WILLIAM J. MAYO, M.D.....Chief of Editorial Staff

AUGUST, 1924

GASTRO–ENTEROSTOMY

IT is a bad old custom to disparage existing conditions as a prelude to the introduction of real or fancied improvements. Surgeons are not immune to this device for making the new seem better than it really is by making the old seem worse than it really was.

I hold no brief for gastro-enterostomy. It is a very good operation, but not so good that it cannot be improved or replaced by better methods. It is to be hoped that eventually methods of direct gastroduodenal union will be evolved which will be not only simple and safe, but efficient and generally applicable. The Finney pyloroplasty, and modifications of the Heineke-Mickulicz operation, such as that of Horsley and the horse shoe gastroduodenostomy of C. H. Mayo are becoming increasingly useful. One must, however, protest against the exaggerated emphasis placed on the defects of gastro-enterostomy as a reason, or, one might say, as an excuse for performing extensive operations in which a large amount of the stomach is removed, because gastro-enterostomy occasionally fails to give the relief expected. To remove primarily two-thirds of the stomach for a gastric ulcer less than 1 cm. in diameter because from 10 to 15 per cent of gastro-enterostomies for such gastric ulcers fail to relieve, or give rise to secondary disorders, all of which are curable, is radical, to say the least. How much more radical it is, in cases of ulcer of the duodenum to remove two-thirds of the uninvolved stomach because 6 per cent of gastro-enterostomies for duodenal ulcer fail to give permanent relief. It is clearly the duty of mortals, who owe to the stomach so many happy sensations, to defend it from aggression.

Bad news travels quickly, and is not readily forgotten. Assuming that 94 per cent of the results of gastro-enterostomy for the relief of ulcer in suitable cases are satisfactory there are six unsatisfactory cases in each 100, and the discontent over the six unrelieved patients leads one to forget the ninety-four who have secured satisfactory results. Gastro-enterostomy does not give the patient a new digestive apparatus; it is not a cure-all which will prevent any kind of gastro-intestinal trouble for life. The person is indeed fortunate, who, with or without a gastro-enterostomy, does not at times suffer from gastro-intestinal disturbances.

In the old days gastro-enterostomy was performed for peptic ulcer, and when in about ten days, the patient left the hospital, he was given good advice with regard to his diet. Now he is given good advice, but too much of it. Formerly it was not uncommon to see a patient two weeks after operation for ulcer sitting in a restaurant, eating without harm, like Jiggs, corned-beef and cabbage and other articles of food which are viewed cautiously

by persons in robust health. Balfour has pointed out that the overemphasis placed on a careful régime for the patient who has been operated on for ulcer suggests to the patient that he is liable to have poor results. Often he becomes introspective and watchful, hunts trouble and finds it. His chance to get well and stay well is not nearly so good as it would have been without the fear-inspiring repetition of too detailed instruction with regard to dietetics.

Following gastro-enterostomy the patient should be advised to take his meals regularly, and to avoid foods which experience has shown are unsuited to him. If he is to attend a banquet, he should take his dinner before he goes, for banquets are usually later than the regular meal and consist of uncommon foods chosen more for the purpose of justifying the price of the meal than for their food value. He should be especially wary of lodge banquets prepared so often by a lodge member who is alone in the opinion that he can cook. Above all, he should avoid stimulants, as he cannot tell from the label what is in the bottle. If for any reason he is obliged to be late to a meal, he should have with him milk in a thermos bottle and a few crackers or cookies, to eat at his regular meal time.

Of the 6 per cent of patients who have trouble following gastro-enterostomy, about 2 per cent develop gastrojejunal ulcer, usually in the suture line, sometimes from silk sutures hanging in the stoma, and occasionally jejunal ulcer a little farther down. The best procedure is to cut off the gastro-enterostomy and perform some type of pyloroplasty, after excision of the original ulcer, or preferably a partial gastrectomy, as we are now doing in a considerable percentage of such cases. In these cases the failure of a conservative type of operation to cure is a solid reason for the removal of a large part of the stomach, since only in this way can we permanently do away with the development of acid secretions which give rise to, or are supposed to give rise to the trouble. However, patients without acids have ulcer, and spontaneous acid-free patients (anacidity and achylia gastrica) as seen in practice, often complain bitterly of gastric disturbances, so-called dyspepsia.

About 2 per cent of the failures of gastro-enterostomy to cure are due to technical errors in performing the gastro-enterostomy. Nearly all surgeons perform the posterior, no-loop gastro-enterostomy, but too many make the anastomosis as short as possible on the jejunum without regard to the position of the stomach in the abdomen. The jejunum brought to the stomach should be of such length as will apply easily, otherwise the stomach will hang on the short proximal limb of the jejunum and will fail to drain satisfactorily. Radiograms taken in such a case after operation will show the gastro-enterostomy apparently too high and too far to the left.

The most serious technical error in performing gastro-enterostomy is failure to expose a sufficient area of the posterior wall of the stomach through the opening in the transverse mesocolon. In many cases in which a second operation is performed on account of the failure of a gastro-enterostomy to relieve, it will be found that the opening in the transverse mesocolon was made too small, and the margins of the opening have dropped down and become adherent to the jejunum where it was applied to the stomach. In some instances the margin of the opening in the transverse mesocolon is not sutured to the posterior wall of the stomach with sufficient care, so that it pulls loose, and the jejunum at the site of the gastro-enterostomy angulates through the opening, causing failure properly to drain the stomach, or chronic biliary regur-

gitation, and sometimes an acute vicious circle. If the opening in the transverse mesocolon is made large and is fastened securely to the posterior wall of the stomach, so that the posterior gastric wall will funnel through at the site of the gastro-enterostomy, such complications will not often occur.

A further source of dissatisfaction with the results of gastro-enterostomy is poor judgment in the selection of cases. When large gastric ulcers exist, a partial gastrectomy should be performed as a primary operation; gastro-enterostomy alone should not often be considered. Again, patients who have had an unnecessary gastro-enterostomy performed, because of mistaken diagnosis of ulcer, are often seen, and the operation is believed to account for the discomfort they suffer. In these cases the history does not suggest ulcer, and subsequent operation has shown no evidence that ulcer ever existed.

Finally, in the remainder of cases, in which gastro-enterostomy has failed to relieve, the unsatisfactory results are usually due to overwork, mental or physical, or obvious dietetic errors; these patients should be under the care of a competent physician.

Let us not be too ready to burn our bridges behind us. By cautery excision and gastro-enterostomy we can cure at least 85 per cent of gastric ulcer, and by gastro-enterostomy or pyloroplasty, with or without excision of the ulcer, 94 per cent of duodenal ulcers. In considering huge gastric resection for simple duodenal ulcer, one is reminded of the early days when it was customary to recommend that the ulcer patient should have had at least nine complete and permanent medical cures before operation. Nine cures were chosen, because it seemed fitting that the stomach should have as much chance for its life as a cat, but if there were no resources in cases of simple duodenal ulcer except resection of two-thirds of a healthy stomach, then at least ten medical cures should be demanded before recommending so radical an operation in the uncomplicated case. W. J. Mayo.

THE LARYNX IN DISEASES OF THE THYROID

IT is frequently assumed, in connection with thyroid surgery, that if the patient's voice is normal, the vocal cords are not paralyzed. The voice, however, may be normal with one cord paralyzed and practically normal with both recurrent laryngeal nerves injured. Although the number of patients who have pre-operative or postoperative cord paralysis is small, it is of vital importance to the surgeon, as a protective measure to himself and to the patient, to be cognizant of the condition if it is present.

Since the work of Semon, in 1881, the proclivity of the abductor muscles of the larynx to become affected first in lesions of the recurrent laryngeal nerve, or of the central nervous system, has been known. Hooper, Donaldson, Semon, and Horsley have added, from an experimental standpoint, to our knowledge of the nerve supply of the larynx. Russell, in experiments on the recurrent laryngeal nerves in dogs, demonstrated that the abductor and adductor fibers are in two distinct bundles which can be isolated. Stimulation of these bundles separately produced abduction or adduction respectively; and section of one bundle resulted in degeneration of the muscle or muscles which it supplied. He anatomically traced the nerve fibers of each bundle to the muscle or muscles which they supplied.

In relation to thyroid disease and thyroid surgery, there are certain clinical facts that do not fit in with some of the experimental work and general accepted theories. It is generally believed that if the recurrent laryngeal nerve is completely paralyzed, the vocal

cord will be in the intermediate or cadaveric position, and that if the vocal cord is in the middle line position, there is abductor muscle paralysis. In most cases of injury to this nerve during thyroidectomy, the vocal cord is in the middle line position after operation. It is unusual to find the vocal cord in the intermediate or cadaveric position after thyroidectomy. If it is, and it does not completely regenerate, it changes to the middle line position, as a rule, in from three to six months.

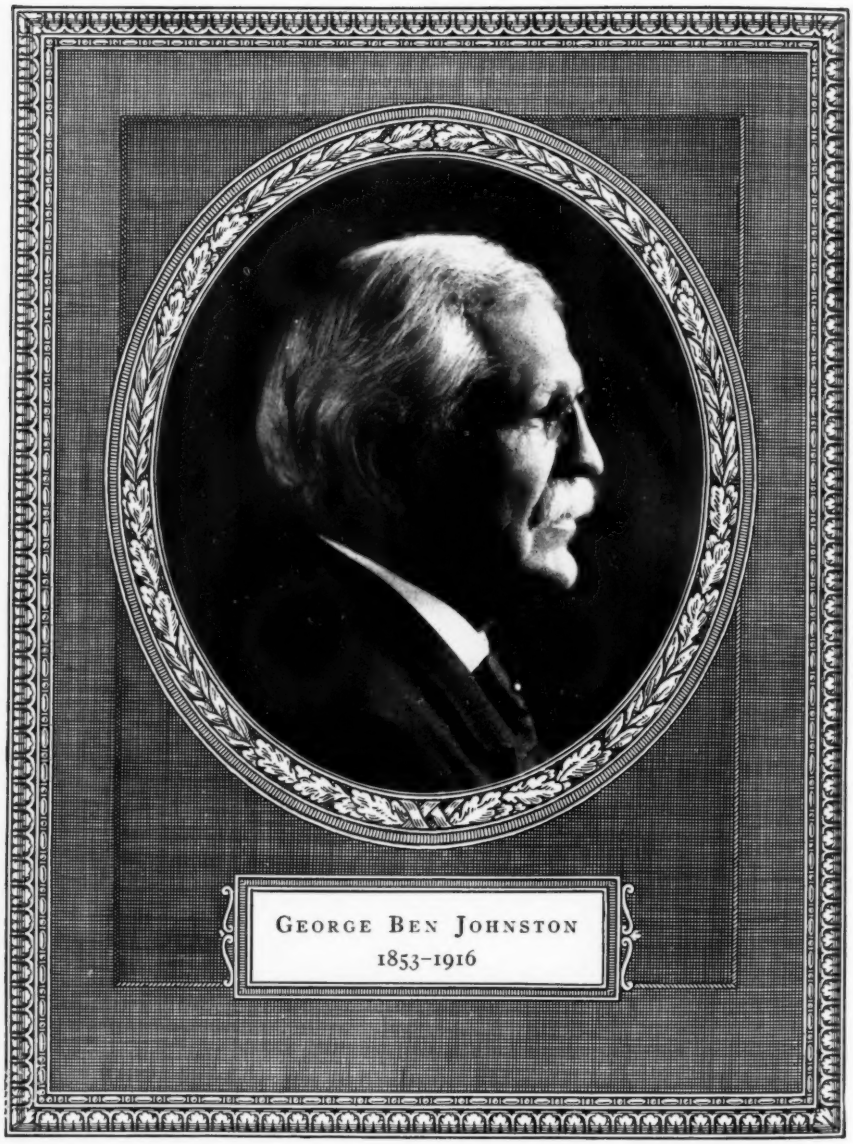
If one recurrent nerve is injured at the time of operation, and the vocal cord is in the middle line position, one-half of the patient's air is immediately shut off, and slight dyspnœa may result until the patient accommodates himself to the limited amount of air which is sufficient for respiration. This slight dyspnœa, if it occurs, is only temporary. However, if the patient has a bad heart or is in poor general condition, cutting off one-half of the air might unfavorably affect the result.

If, before operation, one cord lies in the middle position because of pressure of the gland, the surgeon must exercise additional care when operating on the opposite lobe. If the recurrent laryngeal nerve is injured on the opposite side at operation, a very serious condition arises in which the patient may have marked dyspnœa.

Œdema or hæmorrhage around the nerve may produce a temporary paralysis, or, if these conditions are present around the larynx, they may produce dyspnœa without involvement of the nerve.

The number of cases of serious paralysis of the laryngeal nerve after thyroidectomy is very small, and in these cases the cords are in the middle line position, or so-called bilateral abductor position. This type of paralysis following thyroidectomy is evidenced in three ways: (1) The patient may have marked dyspnœa at operation. The necessity of tracheotomy usually has been attributed to tracheal collapse, but we believe that in some cases it is the result of injury to the laryngeal nerves, which, in turn, allows the vocal cords to come to the middle line position and to cause obstruction. (2) The patient may be dismissed with a normal larynx without paralysis of the cords, and return in from three to six months with increasing dyspnœa and voice still almost normal. (3) The patient may be without voice, but have no dyspnœa and the vocal cords be in the intermediate or cadaveric position immediately following operation. If the injury to the nerves is a permanent one, the patient usually returns in from three to six months complaining of increasing dyspnœa as the voice improves.

The theories as to the cause of the middle line position of the cords following thyroidectomy are varied. The most common explanation is that the abductor fibers of the recurrent laryngeal nerve have been injured at operation or by secondary scarring, and that the adductor fibers bring the cords to the middle line position. It is rather difficult to believe that injury at operation or by external scarring will so injure only the abductor fibers, equally and bilaterally, as to cause the cords to assume this position. It is also difficult to understand that when both cords are in the intermediate position after operation, the adductor fibers regenerate equally and bilaterally and the cords assume this position. In short, we do not know why the cord assumes the middle line position. We do know from clinical observation that this position is assumed by the cords in cases of complete paralysis of there current laryngeal nerve following thyroidectomy. It would seem probable that this position of the cords and their movement is due to the action of the muscles of the larynx which are supplied by the superior laryngeal nerve. G. B. New.



GEORGE BEN JOHNSTON
1853–1916

MASTER SURGEONS OF AMERICA

GEORGE BEN JOHNSTON

DR. GEORGE BEN JOHNSTON was born July 25, 1853 in Tazewell, Virginia. His ancestors were noted pioneers, honored statesmen, famous warriors, and distinguished physicians. His mother, Nicketti Buchanan Floyd, was the daughter of Dr. John Floyd, who was a physician of prominence as well as a governor of Virginia. Dr. Johnston's father was Honorable John W. Johnston, United States senator from Virginia. To these may be added many illustrious relatives, among them Patrick Henry, who was a great-great uncle, and General Joseph E. Johnston of Confederate fame.

Born of this brilliant and sturdy stock and reared among the mountains of southwest Virginia, where the Alleghanies mound in foliage-covered ranges high toward the heavens, or suddenly break into wonderful gaps through which some clear stream works its way toward the ocean after giving liquid sustenance to beautiful and fertile bluegrass valleys, George Ben Johnston grew strong in mind, body, and soul.

In youth, Dr. Johnston's associates were whomever he might happen to meet in a day's journey. He was the intimate friend of the village blacksmith, the mountain trapper and hunter, the town wag and the county scapegoat, as well as of the dignitaries.

The boys of the mountains mostly settled their own disputes and difficulties either by a certain kind of embryo politics or by fist fighting. Young Ben Johnston—he was never called George or Benjamin—was an expert at both. Equipped with a fine memory, splendid reasoning power, patience, deliberateness and withal great attractiveness, sympathy, and far-sightedness, he naturally became a leader in matters open to argument. Handsome, well knit, strong, quick, and fearless, there were but few that could equal him in physical skill or endurance. Although not a quarrel picker he had many Anglo-Saxon fist fights.

Dr. Johnston's education was begun at the Abingdon Academy. Later he went to St. Vincent's, in Wheeling, West Virginia. From St. Vincent's he went to the University of Virginia. Here, for two years, he took academic work and then, following his natural bent, he devoted his third year to the study of medicine. Leaving the University of Virginia he went to the University of the City of New York to finish his medical education, and there he received his degree in

medicine in 1876, at the age of twenty-three. During the following two years he practiced medicine in Abingdon, being associated with Dr. E. M. Campbell, a physician of wide reputation. He left Abingdon in 1878 and settled in Richmond, where he spent the remainder of his life.

From this time on his reputation grew until he became recognized as one of the foremost surgeons of America. In 1879 he performed the first operation in Virginia under "Listerism." He contributed to Keen's *System of Surgery*, Bryant and Buck's *System of Surgery*, and wrote many conspicuous papers, among them being "The Treatment of Osteomyelitis of the Tibia," "Fixation of the Kidney," and "A Description and Report of Cases of the Operation of Splenectomy," and with Dr. Murat Willis he devised and published the Johnston-Willis operation for suspension of the uterus. These and other papers have been extensively quoted.

Dr. Johnston was a born surgeon who, with wonderful energy, vast resourcefulness, and a tremendous practice, kept himself not only abreast but ahead of the times. He did but few exploratory operations. He used every means of his splendid clinical instinct to make a diagnosis, and he was one of the first men in the South freely to call specialists in consultation. In his operations he was deliberate, skillful, astute, and thorough.

Dr. Johnston was, at various times, president of the American Surgical Association, president of the Southern Surgical and Gynecological Association, president of the Norfolk and Western Railway Surgeons' Association, president of the Richmond Academy of Medicine and Surgery, president of the Medical Society of Virginia, a member of the House of Delegates and of the Judicial Council of the American Medical Association, delegate from the American Surgical Association to the International Medical Congress at Madrid in 1903, delegate of the United States to the International Periodical Gynecological Congress in 1896, and had many other honors bestowed upon him. In 1905 he was elected professor of surgery and head of the medical department of the University of Virginia, at Charlottesville, which position, however, he did not accept.

Dr. Johnston was connected with the Medical College of Virginia in various subsidiary capacities until 1884, when he was elected professor of anatomy. In 1893 he was made professor of didactic and clinical surgery; in 1896 this title was changed to professor of surgery and clinical surgery; in 1907 to professor of gynecology and abdominal surgery; later, to professor of abdominal surgery; and when the amalgamation with the University College of Medicine was effected, he was elected professor of surgery, which chair he resigned two years before his death to become a member of the Board of Visitors of the Medical College of Virginia.

He early saw the necessity of a hospital for teaching purposes, and in 1893 he established the Hospital of the Medical College of Virginia, afterward the Old

Dominion Hospital. Soon the necessity for a larger and better equipped hospital became recognized and he interested Mr. John L. Williams, and organized and built the Memorial Hospital. Dr. Johnston always thought that a negro hospital was to be desired in Richmond, and he lent his influence in every possible way to a campaign which was successful in raising $250,000 for a seven story negro hospital and contagious pavillion connected with the Memorial Hospital. He also organized the hospital department of the City Home of Richmond.

In 1909 he and Dr. Murat Willis, built the Johnston-Willis Sanatorium, a hospital for their private surgical practice. As outgrowths of this hospital, the Abingdon Hospital was established in 1910, and the Park View Hospital in Rocky Mount, North Carolina, was organized in 1914. Thus to this one man's instrumentality, five active hospitals owe their existence.

In leadership Dr. Johnston was strong and expected loyalty as he gave loyalty, but he never made unreasonable demands and he fought in the open. Defeat meant to him simply an incentive toward further and more patient effort and the knowledge that he must plan more infallibly, for he knew that if his object was worthy and his plans were correct, success must eventually be his. When his object was achieved, there was no dividing of the spoils, no blare of trumpets, but simply a readjustment to suit the new order of things so that still greater accomplishments might be planned.

Dr. Johnston was a handsome man; in fact, he was unusually distinguished looking. About average in height, his bearing was such that he gave the impression of being taller than he really was. His head was splendidly shaped and his hair, brown and wavy in early life, gray in mid-life, and white later, grew gracefully about his broad, fine brow. His features were regular and clear cut, and he wore a short mustache. His face and forehead were seamed with lines of care, but his complexion was ruddy and his expression extremely mobile. There was no hiding his feelings behind a mask, but he had a way of concealing his thoughts by a quizzical expression, so that one could never tell what question he was going to ask or what he was about to say. As he walked the streets in Richmond, he knew every other person he met, never having forgot their faces and rarely their names. To many he had been their physician, or had rendered them some service, which gave a somewhat intimate personal touch to his greeting.

Dr. Johnston had a high pitched voice which added piquancy to his conversation and probably made one pay closer attention because of its distinctiveness, but which kept him from being a forceful public speaker. In speech he was deliberate, in statement accurate, in argument conclusive, and it has been truthfully said of him that he was "powerful in counsel." His courtly and gracious manner, his distinguished appearance and elegance of poise were such that, upon his entrance, he immediately became the center of attraction of nearly any gathering, and men instinctively paid him deference. His stories, anecdotes, and say-

ings his friends will never forget, but only one may be mentioned here. During one of the sessions of the Virginia Legislature a very undesirable osteopath bill came up for committee hearing. Ex-Governor Charles T. O'Ferrell was attorney for the osteopaths and Dr. Johnston represented the interests of the medical profession. During his speech Ex-Governor O'Farrell stated that the medical profession built a fence around itself which was *horse high, bull strong, and pig tight,* and he repeated this phrase time and again. When Dr. Johnston arose he ignored all the rest of his opponent's speech and responded in his quizzical and deliberate way, in his high pitched voice, "Yes, gentlemen, it is perfectly true that the medical profession builds a fence around itself which is horse high, bull strong, and pig tight, but it is with no idea of excluding those who can enter through its scientific gates, but simply to keep the jackasses out." He sat down and the bill was killed in the committee.

With an inexhaustible fund of information gathered from an active life full of experiences, and with a deep insight into human nature, he was always an instructive and interesting conversationalist.

Dr. Johnston had an enormous surgical practice and a most grateful clientele. As he went from room to room making his rounds, it was a rare treat to see him infuse the radiance of his wonderful personality into the sick room. A few perfectly chosen words from him would change the whole attitude of a patient from dejection to hope or from despair to resignation. Possessing a vision almost prophetic, with advice, encouragement, and assistance, he guided many a medical career through college, through hospital and special training, to the fruition of a large and useful practice. His time, his labor, his resourcefulness and his influence were ever at the disposal of those who wished them.

Previous to the last few years of his life, Dr. Johnston had been in practically perfect health, and except for an attack of catarrhal jaundice he had never been in bed a day. The feeling of either mental or physical fatigue was almost unknown to him and he had rarely taken a dose of medicine.

Several years before his death Dr. Johnston began to suffer from angina and frequently he would have an attack and turn and walk to the window or stop on the street to look at something and take a nitroglycerine tablet in such a way that those who were with him did not know that he was in the least uncomfortable. He would often tell his intimates: "God bless the man who invented nitroglycerine!" He was on his feet to within a few weeks of his death, which occurred on December 20, 1916. His wife and four daughters survived him. The whole state mourned its loss and it was been written of him—

"No duty could overtask him,
"No need his will outrun,
"And ere our lips could ask him,
"His hands the work had done."

BEVERLY R. TUCKER.

CORRESPONDENCE

BIOPSY OF SUSPECTED GROWTHS OF THE RECTUM AND SIGMOID

To the Editor: In order to obtain definite knowledge concerning the nature of a growth in the lower part of the large intestine, it is necessary at times to remove a section for microscopic study.

When the tumor is situated in the lower portion of the rectum, a satisfactory idea of it may be obtained by palpation, but even then it is comforting to have clinical judgment confirmed by pathological findings before serious operation is advised. With a suspected process in the rectum or lower sigmoid, beyond the reach of the finger, visual examination alone can not give an accurate idea of the depth, consistency, degree of infiltration, and other facts essential to correct judgment. Therefore a simple and safe method of obtaining a specimen of the tissue and microscopic examination of it becomes necessary. To cut off a section of a suspected growth with a pair of scissors is only practicable when the mass is low down. Working through the proctoscope, it is impossible to separate the blades widely enough—a difficulty increased in direct proportion to the distance from which the operation is undertaken. Other instruments on the market with which a piece of tissue may be cut out are so constructed that they open in the transverse axis of the bowel and a deep and invisible section of the growth is enclosed between the jaws of the "punch." This is liable to cause bleeding, which is hard to control high up in the bowel.

To overcome these difficulties the writer found a good use for a bad instrument in the tonsillotome formerly so popular in the surgery of enlarged tonsils. With this, a piece of tissue is fixed securely and steadily by the prongs of the instrument and is sliced off clean from the surface. The cutting edges of the tonsillotome operate in a vertical plane, and it is not only unnecessary to cut deep and risk danger from hæmorrhage, but a larger part of the surface becomes available for examination.

To obtain tissue from a flat, ulcerating growth in the lower sigmoid, the rectal scoop, a long handled instrument is bent at its proximal end to an angle of 45 degrees, and provided at its distal extremity with a blunt edged cup. With this the surface is curetted. The recovered tissue is then frozen and sectioned. By this method a diagnosis was made in one case of a very early adenocarcinoma of the sigmoid, confirmed by operative findings 4 months later.

ARTHUR A. LANDSMAN, M.D.
New York

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD MARCH 21, 1924, DR. CHARLES S. BACON, PRESIDING

FIBROMA OF THE OVARY; KRUKENBERG'S CARCINOMA OF THE OVARY; CHORIOEPITHELIOMA OF THE TESTIS

DR. SIDNEY SCHOCHET: The first specimen I present is a comparatively rare tumor, that is, a fibroma of the ovary. Fibromata appear to be teratoid in origin because they usually arise from the lateral surface of the ovary. This tumor also contained some muscular fibers, and was a very firm mass. I reviewed the literature as far as I could, and found about 80 cases recorded.

The second case is a Krukenberg's carcinoma of the ovary. It is unilateral. No primary tumor could be determined in the gastro-intestinal tract. The cells appear as signet rings. I record this for the simple reason that it is a primary Krukenberg's tumor without cysts. Some of the cases reported as such have been carcinoid carcinomata arising from the ovary. All of these cases prove fatal. I hope my patient will live a long time, but if she dies I hope to get an autopsy.

The third case is the second one of its kind I have seen in the last 9 months, which makes the ninety-first case on record. I had Dr. Reis and Dr. Ewing look at it. Dr. Reis confirmed my diagnosis. Dr. Ewing was a little bit skeptical. We have definite syncytial cells and definite cells of Langerhans. I report this case because it brings home to us that chorio-epithelioma does not necessarily arise from placental tissue. We must look at it as arising from some primordial fetal cell.

CARCINOMA OF THE KIDNEY

DR. W. C. DANFORTH: I would like to show a specimen of carcinoma of the pelvis of the kidney. The patient was a woman of 64. A diagnosis of tumor of the kidney was made 3 months ago in another hospital but she declined any operative interference. She was terribly emaciated with an enormous mass in the right hypochondrium. Apparently nothing could be done surgically, but at the urgent request of the family a short incision was made, which was closed promptly. She died about a week or 10 days later. The autopsy disclosed an enormous kidney, almost the entire bulk of which was taken up by the tumor mass. Microscopic section showed a squamous cell carcinoma of the kidney. The autopsy also showed in the bladder secondary tumors which can be seen very plainly in the specimen, the one covering the right ureter being histologically similar to the kidney tumor. The specimen shows a mass of carcinoma growing out from the renal vein into the vena cava.

These carcinomata of the kidney are rather uncommon. Both Dr. Williams, our pathologist, and I thought it was probably a papillary carcinoma. It is a squamous cell carcinoma. This is the second carcinoma of the kidney which we have encountered on our service in 2 years. I think that we who are doing gynecological work should remember the frequency with which urological conditions occur. So far this year we have had two ureteral strictures and one Hunner's elusive ulcer in addition to the specimen shown tonight.

DISCUSSION

DR. EMIL RIES: Will Dr. Danforth tell us about the origin of that tumor? If it was a squamous cell carcinoma where did it come from?

DR. W. C. DANFORTH: I do not know.

DR. J. L. WILLIAMS: I think the origin was likely in the renal pelvis. The cells resembled in some respects those of a tumor of the renal pelvis containing transitional epithelioma and it occurred to me that that was the most likely seat of origin of this tumor. The tumor occupies that portion of the kidney usually taken by the renal pelvis.

DYSTOCIA FROM THE RUPTURE OF A DERMOID CYST DURING LABOR

DR. BERTHA VAN HOOSEN: Patient, 17 years of age, gravida I, negative history and Wassermann was admitted to the Cook County Hospital at 5 p. m. on March 11, 1924. Labor had begun at 4 a. m. of the same day. On rectal examination it was found that the bag of waters had ruptured, cervix was effaced and the os was dilated 1 to 2 centimeters. Maternal pulse was 80, fetal heart tones 140. Pelvic measurements were 22½, 24½, 28½ and 19, diagonal conjugate 9. First stage ended at 1:45 p. m. on the 11th, there being no progress for one hour. Examination was made and revealed a mass which was thought to be attached to the rectovaginal wall and which made delivery per vaginam impossible. Cæsarean section was advised.

I was called at 2:30 p. m. and on making an examination I found a tumor mass in the posterior cul-de-sac extending downward and obstructing the passage of the head. Thinking that it was barely possible that an ovarian tumor had ruptured and that the contents were obstructing the head I felt it would be wise to make a posterior colpotomy, drain off the ruptured tumor contents and possibly push the sac up out of the pelvis. An incision into the posterior vaginal vault was followed by the discharge of a thick yellowish material in which were particles resembling hair. Further examination within the operative wound revealed a thick walled collapsed tumor mass which was removed by sponge holder. The sac had no attachment to anything within the pelvis. Within the sac there was hair. The tumor mass had the remains of a pedicle which had been completely ground off, probably by the downward passage of the head. A gauze drain was inserted into the posterior colpotomy incision and shortly after the head came down to station + three but no further progress was made for an hour. The next operation was the application of low forceps as the pelvis was large enough for the passage of the fetus. Prior to the application of the forceps a bilateral anterior episiotomy was performed.

At the present time the mother is in fair condition and the baby is in good condition.

I thought this case interesting in that it illustrates three points: (1) The force of the contractions of a uterus that would grind off the pedicle of a tumor in an absolutely bloodless manner must be tremendous. Not one drop of blood was noted in the material discharged from the pelvic cavity. (2) We may have gone a little too far in rectal examination. If this patient had had a vaginal examination at the beginning of labor an early cæsarean section would have been indicated. (3) We hear a great deal about the contents of a dermoid being so terribly irritating. In this case the entire contents were poured out into the peritoneal cavity, yet the patient with the exception of having a little temperature has had a very uneventful convalescence. If peritonitis were going to develop as the result of the intraperitoneal rupture of the dermoid cyst it would doubtless have done so before now.

BENIGN TUMORS OF THE PLACENTA

DR. R. A. SCOTT presented a paper on "Benign Tumors of the Placenta." (See page 216.)

DISCUSSION

DR. EMIL RIES: I have seen only one tumor which was exactly the same as this. I reported it to this Society about 20 years ago. The essayist's literary review is rather interesting especially as to the various theories concerning the origin of these tumors. How anybody can consider congestion or arteriosclerosis of the mother as the cause of a disturbance in the vessels of the chorion is rather difficult to see in the light of our present knowledge of the absolute lack of connection between the maternal and fetal vessels. Besides there is no evidence anywhere in pathology pointing to any possibility of angiomatous tumors being produced by congestion. There is no more frequent congestion in vessels than that seen in varicose veins of the lower extremities, yet the practically complete absence of tumor formation in these veins should discount any theory of congestion as the cause of tumors in the placental vessels.

I do not know of a single case of angioma of the placenta in the presence of an angioma in the child—not that I think of this as a sort of metastases of angiomatous tumors of the placenta into the child, rather I would think of the possibility of systemic disease of the vascular system leading to multiple tumor formation. I am interested in that because just recently I saw a young girl who came to me 2 years ago with multiple blackish tumors of the foot. She had at that time five tumors. She had had six but one had been extirpated by some one and examined microscopically and diagnosed melanotic angiosarcoma. Under that diagnosis the girl had been given up. She had refused amputation which was proposed by the first surgeon and she made the rounds of the various clinics and by and by appeared at our clinic. She was given X-ray treatment for some time but while under treatment developed two more tumors so that now she had eight counting the one which was extirpated. The two new ones were a little higher up. As I was doubtful about the malignant nature of these tumors I asked permission to take out one. It was a plain angioma, with nothing malignant about it. Plain angiomatous tumors are benefitted more by radium than X-rays. The patient is receiving this radium treatment now. I diagnosed the case systemic disease of the blood vessels rather than metastases of a malignant type. We might think of the possibility of systemic disease of the blood vessels in the placenta and fetus and the attention of the gentleman is invited to the possibility of discovering such a case.

DR. W. C. DANFORTH: I would like to suggest the value, as indicated by this interesting presentation, of routine pathological examination of the placenta, such as is now being carried out in a good many institutions. We have been doing that for the past 4 or 5 years and various things have been voted that otherwise might have been overlooked.

DR. SYDNEY SCHOCHET: I would like to ask Dr. Ries if radium or X-rays cause a more marked metastasis in melanotic sarcoma arising from the blood vessels. I recall a case at the Philadelphia General Hospital in which there was a limited area in which radium was used for 3 or 4 weeks. The woman had millions of these melanotic sarcomata over the body, a general sarcomatosis. At autopsy the whole peritoneal cavity was literally covered by these tumors. I recall that in the discussion at that time it was said that radium and X-ray would stimulate the growth of these tumors.

DR. EMIL RIES: Dr. Schochet speaks of a malignant tumor. I do not consider this a malignant

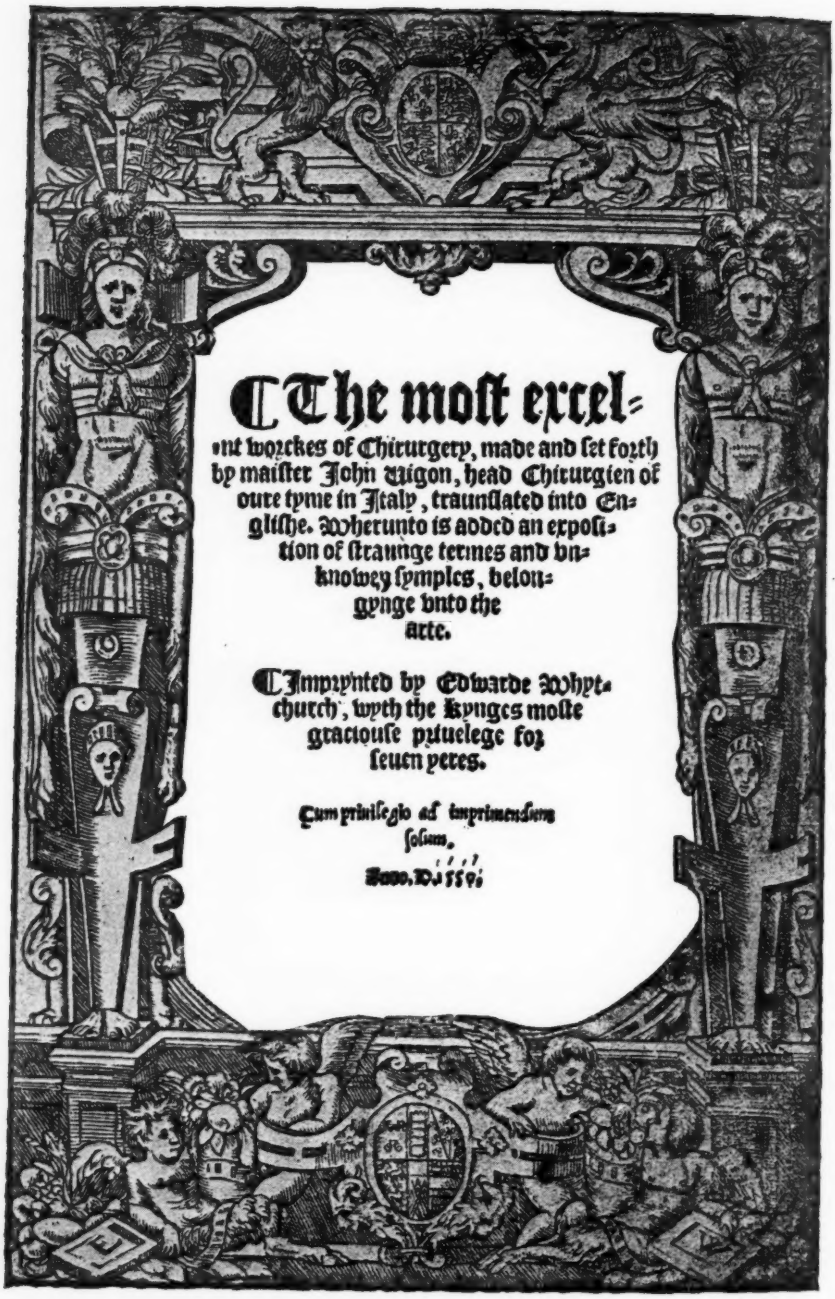
tumor. The doctor speaks of melanotic tumor. This is a plain angiomatous tumor and not melanotic. The dark color is due entirely to coagulated blood and not to the presence of melanotic pigment.

DR. CAREY CULBERTSON: A study of the literature shows that there is not a concensus of opinion with respect to the nature of these growths. By some they are accepted as true neoplasms. When they are encapsulated and discrete like this tumor of Dr. Scott's and like many of the others reported, they certainly appear to be true angiomata and therefore true neoplasms. Some writers, particularly Planchu and Savy, regard them as representing a thrombosed retrograde, degenerative process, as a result of which, there being a thrombosis of the large vessels, dilatation of the capillaries produces a condition looking like angioma. In such cases, however, there is a rather diffuse arrangement, not so discrete and accompanying them there is more apt to be hydramnios, death of the fetus and premature labor, all three conditions suggesting a syphilitic origin. The relation, in other words, between chorio-angioma and syphilis has not been ruled out, though the fact that, where it has been discovered, gumma in the placenta has not been coincident would tend rather to disprove syphilis because if the growths were syphilitic in origin one would expect the placenta to show other evidence of syphilis.

The tumors were distinctly benign, as Dr. Ries has pointed out, in every case. Nebesky some 10 years ago reported 88 cases gathered from the literature, adding one from his experience all of which were distinctly benign.

DR. J. L. WILLIAMS: I might say that the surfaces made by cutting this tumor were strikingly like those of an organized blood clot in the placenta and at first this is what the tumor appeared to be, though it was distinctly encapsulated and could be shelled out of the capsule; but the microscopic sections showed that it was composed, as Dr. Scott has shown, of multiple blood vessel spaces of various sizes lined with epithelium. The thrombosed vessel running into this was apparently secondary as the tumor had undergone some retrogressive changes due to this thrombosis, so that so far as the thrombosis causing the tumor was concerned, I do not think that likely.

DR. GUSTAV KOLISCHER read a paper entitled, "The Modern Theories of Electricity in Their Bearing on Roentgenology."



¶ The moſt excellent worckes of Chirurgery, made and ſet forth by maiſter John Vigon, head Chirurgien of oure tyme in Italy, traunſlated into Engliſhe. Wherunto is added an expoſition of ſtraunge termes and vnknowen ſymples, belonginge vnto the arte.

¶ Imprynted by Edwarde Whytchurch, wyth the kynges moſte gracious pryuelege for ſeuen yeres.

Cum priuilegio ad imprimendum ſolum.

Anno. M.D.lv.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

By ALFRED J. BROWN, M.D., F.A.C.S., Omaha, Nebraska

THE SURGERY OF JOHN DE VIGO

The practice of surgery in Italy began practically with Giovanni de Vigo of Rapallo near Genoa. He was born in 1460 and died in 1519 and was the father of the so-called Roman school of surgeons. In medicine he followed the footsteps of his father Batissta di Rapallo who is said to have been the inventor of the "apparatus major," a method used in lithotomy. Batissta did not instruct his son in this method but, according to Baas, communicated it to Giovanni de Romanis of Cremona. Ultimately it came to Mariano Santo di Marletta (1489–1539) and was published by him in 1531. It was learned by Ottaviana da Villa, an itinerant surgeon who practiced lithotomy and by him taught to Colot through whom it reached France.

Being the son of a physician, John de Vigo took up the same line and became a great student of the former masters, but did not progress very far beyond them as his book is filled with references to Hippocrates, Galen, Avicenna and so on and is practically a compilation of their work. He seems to have been a very well read man and a hard student but not much of an independent thinker.

The Italian surgeons of the time had a somewhat inflated idea of their dignity and believed that working with their hands put them on a lower social plane. So de Vigo believed that operations were much beneath the dignity of a learned man and should be referred to the itinerant physicians. This may be one of the reasons why his father's lithotomy was not transmitted through him. De Vigo did, however, introduce the crown trepan and for hæmorrhage used the ligation of the older masters in which the vessel was transfixed by a needle and tied above it as in the hare-lip suture.

His book was translated into English by Bartholomee Traheron and dedicated by him to Rychade Tracie. It bears as its title (as shown in the illustration):

"The Most Excellent Workes of Chirurgery, made and set forth by maister John Vigon, head Chirurgien of our tyme in Italy, translated into Englishe. Wherunto is added an exposition of straunge termes and unknown symples, belongynge unto the arte." It was printed by Edwarde Whytchurch in 1550. Neither Tracy nor Traheron were physicians but both were students of early scripture and higher learning of all kinds. Tracy had taken care of Traheron who was left an orphan at an early age and educated him both in England and abroad and the translation of de Vigo's work was an appreciation of this kindness by Traheron, and rather an exhibition of his ability at translating than a desire to render any great service to medicine. Traheron's opinion of medicine was not very high and he did not particularly approve of it but believed that most diseases were the punishment of sins. He begins his dedication by saying "God the myghtie governer of all thynges, long tyme sythens, hath witnessed, by his excellent prophet Moses, yt for the transgression of his holy lawes, he wolde plage the people wt sondrye, & grevouse disease. Howbeit our blindenes hath ben so great, yt in the multitude of most fylthye, and shameful botches, sores, & other pitious maladies we have not perceaved, how horrible a thynge synne is, & how present vengeau (n)ce the dyspisyng, and neglecting of goddes dredfull co(m)au(n)deme(n)tes, bryngeth uppon us, no not when we have be burnte wyth fyery carbuncles, nor when oure fleshe hath bene toren from the bones, & eaten up wythe lothsome cankers, nor whe(n) we have ben myserably torme(n)ted, wyth yt moste fylthy, pestiferous, & abominable dysease the frenche or spanyshe pockes." Later in order to justify himself he says that for the purpose of helping mankind God gave "Vertues to herbes, stones, trees and metalles, where wyth our evels myghte be eased, & also styrring up me(n) to note suche thynges, and to practyse them upo(n) our paynfull griefes." The introduction is so heartfelt that one is led to wonder if some ailment of his own did not lead Traheron to study and translate de Vigo's work and to pick this author out as he was not an operator but preferred treatment by salves and ointments at which he was a master.

De Vigo's work as a whole follows the usual form of the surgeries of the time. First, after an index, he gives a short résumé of the Galenic anatomy. He then diverges a little and discusses inflammations of various types as well as adds a chapter on syphilis before taking up fractures and dislocations to which he devotes only a short space. The remainder of the work contains an antidotary; a discussion of various medical conditions (among which is a rather full discussion of Tertian fever) and closes with a chapter of definitions of "straunge" words which are really medical terms.

His name still remains in our modern pharmacopeia, attached to Emplastrum de Vigo or mercurial plaster of which he was originator.

BOOK REVIEWS

A REVIEW OF NEW BOOKS IN SURGERY

THE little volume on ulcers of the stomach and duodenum[1] is one of the series of medical monographs now being published in France. The aim of these monographs is to make available for the practitioner and the advanced student the information scattered through the larger treatises and textbooks.

The volume under discussion, in the opinion of the reviewer, accomplishes this purpose very well. There is a brief historical sketch of the development and growth of our ideas regarding the peptic ulcer. This is followed by an analytical detailed discussion of the symptomatology and diagnosis. Each symptom and sign is carefully evaluated. The various adjuvants in the diagnosis such as the stomach tube, fluoroscopy, roentgenography, etc., are thoroughly discussed.

The authors regard the views of their Anglo-American confrères as somewhat too dogmatic. This particularly refers to "Moynihan's Syndrome." On the whole, however, their views are much the same as ours. The volume sums up the knowledge up-to-date. The authors display familiarity with the work of the English and American writers, carefully avoiding mentioning German names prominently associated with this field. The war is evidently not quite over.

ONE cannot help but be amazed at the progress made during the past decade in all branches of civic, industrial, commercial, and scientific enterprises. Modern methods draw the world very closely together. They stabilize the world as it were. To say a method is American or English is practically to confess ignorance. Rapid transportation, the wireless, the aeroplane place us all under one roof. A method is no sooner born in one country than other nations know of it and are ready to dispute it or sanction it. Scientific medicine is certainly no exception to this, as is manifested by the almost countless number of foreign physicians who are constantly seen in America, and the number of American physicians who are planning to spend a fortnight in Europe to "brush up." It is very apparent that this intimate fusion of ideas and thought will not permit national methods or habits except as they may be influenced by climatic necessities and economic conditions. This is very clearly exemplified in the re-edition of the *System of Surgery*[2] edited by Choyce. In this system of surgery we have incorporated English surgery as it is taught and practiced by English surgeons of the first rank. It is no better and no worse than American surgery at its best, in fact it is surgery at its best as practiced in all modern and progressive nations of today.

This re-edition was begun in 1914 but the stern responsibilities of the war caused years of delay and not until 1921 was the task resumed. The system consists of three volumes, edited by C. C. Choyce. Among the contributors may be found the master English surgeons, masters not only of surgical diagnosis, pathology, and technique, but masters of English phraseology and rhetoric. Volume I covers the general principles of surgery and certain specific diseases. The very lucid description of the process of suppuration by Sir G. Lenthal Cheattle, and the chapter on tumors by Raymond Johnson and T. W. P. Lawrence are written in a masterly way and for clarity and completeness are rarely surpassed. Volumes II and III are devoted to regional surgery, and here again are certain outstanding chapters. Handley presents the surgery of the breast in a most masterly fashion. He devotes much attention to carcinoma and to his theory of permeation of cancer, the latter being accepted more and more by surgeons the world over. There is a comprehensive chapter on the tongue by W. H. Clayton Green. An unusually interesting and instructive description of the surgery of the stomach and duodenum is presented by Sherren. The surgical diseases of the intestines are presented by Alexander Miles and again this master surgeon does not disappoint us. Probably the best chapter in this entire voluminous work is that written by Wilfred Trotter on the scalp, skull, and brain. Every phase is entered into in a most critical manner. Concussion and its mechanism of production is described in a fascinating way. His analysis of the symptoms of brain injury as they may influence a correct diagnosis and the indication for treatment, is very logical and certainly opens the way for a clearer understanding of this complex problem. Some of the chapters were rather disappointing to the reviewer; among these the chapter on the female genital tract and that devoted to fractures.

A tremendous amount of information is presented in these volumes in a very pleasing manner. The text is profusely illustrated, many illustrations being in colors and exceedingly well done. The work is a distinct asset to a surgeon's library.

[1] LES ULCÈRES DE L'ESTOMAC ET DU DUODENUM. By Ed. Enriquez et Gaston-Durand. Paris: Masson et Cie. 1924.

[2] A SYSTEM OF SURGERY. vols. i, ii, and iii. Edited by C. C. Choyce, C.M.G., C.B.E., B.Sc., M.D., F.R.C.S. Pathological editor, J. Martin Beattie, M.A., M.D., C.M. New York: Paul B. Hoeber, 1923.

HERNIA is one of the most common surgical conditions confronting the medical profession today. During the past decade or longer the student and interne have been taught in many instances that practically the final word has been said. This is a serious mistake as is demonstrated by some recent investigations, notably those of Seelig and others. Failures in the past have been more frequent than we were allowed to believe. A work which incorporates a greater part of the data on hernia up to the present time is certainly desirable. The recent volume by Watson[1] is such a work. The author does not claim anything new or original but presents "within reasonable space the most important features of the anatomy, etiology, symptoms, diagnosis, differential diagnosis, and prognosis of hernia, together with the best operative technic of modern surgeons." Two outstanding features of this work are more than worthy of comment, the very complete and interesting historical sketches which preface many of the chapters and the extensive bibliography. These two features at once stamp this work as a tremendous task consummated.

Many of the pitfalls which the younger surgeon might fall into are discussed. The rarer forms of hernia are described in great detail and beautifully illustrated. Practically every complication of hernia and its treatment are taken up in a very logical manner and in a closing chapter consideration is given to the medicolegal aspect of this condition. The text is profusely illustrated and here again it is but just to compliment the author for the excellent work of his artist, Mr. Shepard. This work can be heartily recommended to the student and to the practitioner alike who may be seeking data on the subject of hernia.

THE little monograph[2] by Morley is indeed most welcome. However much we may know about hæmorrhoids, there is still much to learn, and the medical profession as a whole is most ignorant and careless about this common malady. The question often arises, Does an operation cure hæmorrhoids so long as the questionable etiological factor remains? No doubt many cases are very much benefited or are cured by operation, not a few are made worse, and a certain number are not benefited at all. These facts must mean that we as a profession are not devoting enough energy toward clearer understanding of this very common condition. Therefore any work placed before the profession which causes comment and criticism will be constructive. The outstanding feature of this little work is the author's method of treating internal hæmorrhoids and his results. He advocates the injection of internal hæmorrhoids with a 20 per cent solution of carbolic acid in glycerine at weekly intervals. His results in the treatment of some 3,500 cases are phenomenal and surely warrant the serious consideration of the medical profession. The method is devoid of danger and the disability is practically nil. It is the reviewer's opinion that this procedure should be more frequently used and that possibly in time, operation for internal hæmorrhoids can be entirely dispensed with. The author should be congratulated for his stand on this subject and for the presentation of this monograph.

JOHN A. WOLFER.

A WOMAN'S Quest[3] is a book well worth reading and will appeal to two classes of people: Men and women who are broad enough to recognize mental equality without sex antagonism; and women engaged in professional and educational advancement.

Dr. Marie Zakrzewska was an example of perseverance, stability, skill, and determination such as few possess. She strove against social ostracism, prejudice, and all kinds of hardships and privations. To those of us following her line of work she is an inspiring influence and example.

In her study of different subjects, religion, spiritualism, etc., as well as in her ability to establish hospitals and dispensaries in the face of seemingly insurmountable obstacles she exhibited rare tact, much knowledge, and a universal tolerance.

One of Dr. Zakrzewska's Cleveland friends says of her wide reading: "She always knew the best apple on every tree of knowledge and her mind was stored with the condensed wisdom of many libraries."

Anyone disheartened in trying to maintain a principle or reach a goal should read this book.

JULIA C. STRAWN.

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[1] HERNIA; Its Anatomy, Etiology, Symptoms, Diagnosis, Differential Diagnosis, Prognosis, and Operative Treatment. By Leigh F. Watson, M.D. St. Louis: C. V. Mosby Company, 1924.

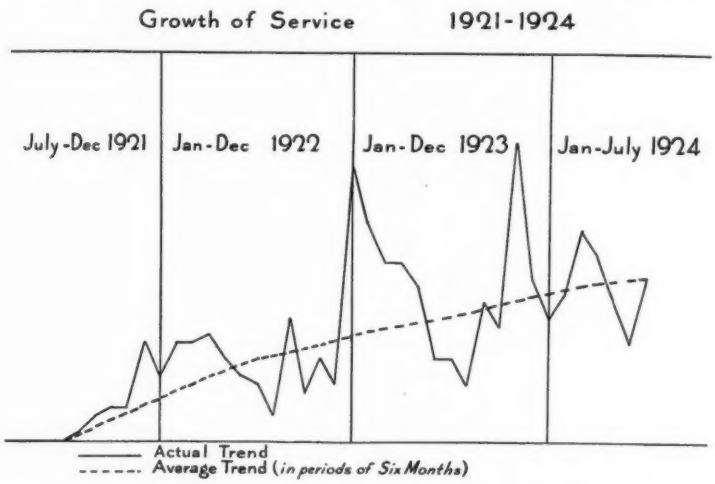
[2] HÆMORRHOIDS; Their Etiology, Prophylaxis, and Treatment by Means of Injections. By Arthur S. Morley, F.R.C.S. (Eng.). London: Henry Frowde and Hodder & Stoughton, 1923.

[3] A WOMAN'S QUEST. The Life of Marie E. Zakrzewska, M.D. Edited by Agnes C. Vietor, M.D., F.A.C.S. New York and London: D. Appleton and Company, 1924.

AMERICAN COLLEGE OF SURGEONS

GROWTH OF SERVICE OF THE DEPARTMENT OF LITERARY RESEARCH

THE increasing demand for the service of the Department of Literary Research calls for a proper distribution of requests throughout the year. This can best be illustrated by the accompanying graph. The peak comes each year in the fall and the lowest point in midsummer.



There is a distinct advantage to those using the service for papers for the fall and winter meetings when the requests can be sent in early. Comprehensive pieces of research work are handled to advantage during the summer months. Emergency requests are not to be discouraged, however, as the Department stands ready to serve at the convenience of the surgeon.

The number of requests for research work practically doubles the number of the year before. The present year begins low as the peak has been advanced because of the effort made last fall to get the requests in early. A large proportion are now repeat requests from surgeons or groups of surgeons who have used material prepared by the Department.

Although the Fellows located near the Library of the College were the first to use the service, the Department is organized to serve the members wherever they are located. The field of service has now been extended from England to Korea and from Canada to South America.

Requests are received for bibliographies, abstracts, and translations for use in connection with the preparation of papers on medical and surgical subjects. Data has also been compiled direct from hospital records to supplement the surgeon's material or furnish data from different sections of the country for comparison. Of even greater interest are opportunities to be of service in the surgeon's practice, to furnish information from the literature applicable, for example, to an unusual case under his observation or to some new method of treatment. The Department also has charge of continuous pieces of research whereby the surgeon is furnished with reports of current literature on the subject of his interest.

The type of work in any case depends upon the surgeon's request. It varies from the selecting of loan material from the Package Library to the preparation of a most comprehensive review of the literature.

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THE FOURTEENTH ANNUAL SESSION IN NEW YORK AND BROOKLYN

WEEK'S PROGRAM IN BRIEF

Monday, October 20

10–12. Hospital Conference, Ballroom, Waldorf-Astoria. Papers and discussions.
2–5. Hospital Conference, Ballroom, Waldorf-Astoria. Round table conference.
8. Presidential Meeting, Ballroom, Waldorf-Astoria. Inaugural address of President-Elect and Murphy Oration on Surgery.

Tuesday, October 21

9–12. Clinics and demonstrations at the hospitals and medical schools.
10–12. Hospital Conference, Ballroom, Waldorf-Astoria. Papers and discussions.
2–4. Clinics and demonstrations at the hospitals and medical schools.
2–5. Hospital Conference, Ballroom, Waldorf-Astoria. Round table conference.
8. Scientific session, Ballroom, Waldorf-Astoria. Section on general surgery, etc., papers and discussions.
Scientific session, Empire Room, Waldorf-Astoria. Section on surgery of the ear, nose and throat, papers and discussion.

Wednesday, October 22

9–12. Clinics and demonstrations at the hospitals and medical schools.
2–5. Clinics and demonstrations at the hospitals and medical schools.
8. Scientific session, Academy of Music, Brooklyn. Section on general surgery, etc., papers and discussions.

Thursday, October 23

9–12. Clinics and demonstrations at the hospitals and medical schools.
2–4. Clinics and demonstrations at the hospitals and medical schools.
Annual meeting of the Fellows of the American College of Surgeons, Ballroom, Waldorf-Astoria.
8. Scientific session, Ballroom, Waldorf-Astoria. Section on general surgery, etc., papers and discussions.
Scientific session, Empire Room, Waldorf-Astoria. Section on ophthalmic surgery, papers and discussions.

Friday, October 24

9–12. Clinics and demonstrations at the hospitals and medical schools.
2–5. Clinics and demonstrations at the hospitals and medical schools.
8. Twelfth Convocation of the American College of Surgeons, Ballroom, Waldorf-Astoria.

THE large number of registrations for the New York-Brooklyn meeting already received at the office of the Director-General would indicate that the limit of attendance will be reached weeks in advance of the meeting. It will be necessary to enforce strictly the rule limiting attendance to a number that can be comfortably accommodated at the clinics. The limit of attendance is based upon the result of a survey of the amphitheatres, lecture rooms and laboratories in the several hospitals and medical schools as to their capacity for accommodating visitors. This plan necessitates registration in advance on the part of all who wish to attend, and when the limit of attendance has been reached through advance registration, no further applications can be accepted.

Attendance at clinics and demonstrations is controlled by means of special clinic tickets, which plan has proved an efficient means of preventing overcrowding at the clinics and provides for the distribution of the visiting surgeons among the several clinics. The number of tickets issued for any clinic is limited to the capacity of the room in which that clinic is given.

The preliminary clinical program, revised and corrected to date, will be published in the September issue of this journal. The real program of the Congress will be issued daily during the session; it will be posted each afternoon on bulletin boards at headquarters giving a complete detailed description of the clinics and demonstrations to be given on the following day.

All branches of surgery will be represented in the program, an important feature of which will be a series of clinical demonstrations, or "dry clinics," in which surgeons, internists, pathologists, roentgenologists, and other specialists will participate, bringing to bear on important surgical and border-line subjects the newer ideas as developed in various departments of medicine.

Programs for the evening meetings are being prepared by the Executive Committee of the Congress. On Tuesday and Thursday evenings in the Ballroom of the Waldorf-Astoria and on Wednesday evening in the Academy of Music in Brooklyn papers dealing with subjects of interest to the general surgeon, gynecologist, urologist, orthopedist, and obstetrician will be presented by eminent surgeons of the United States and Canada and distinguished visitors from abroad. Programs are also being prepared for two special meetings, at which papers and discussions will deal with subjects of special importance to those interested in the surgical aspects of ophthalmology, otology, rhinology and laryngology, to be held in the Empire Room of the Waldorf-Astoria on Tuesday and Thursday evenings. It is expected that the complete program for the evening meetings will be published in the September issue.